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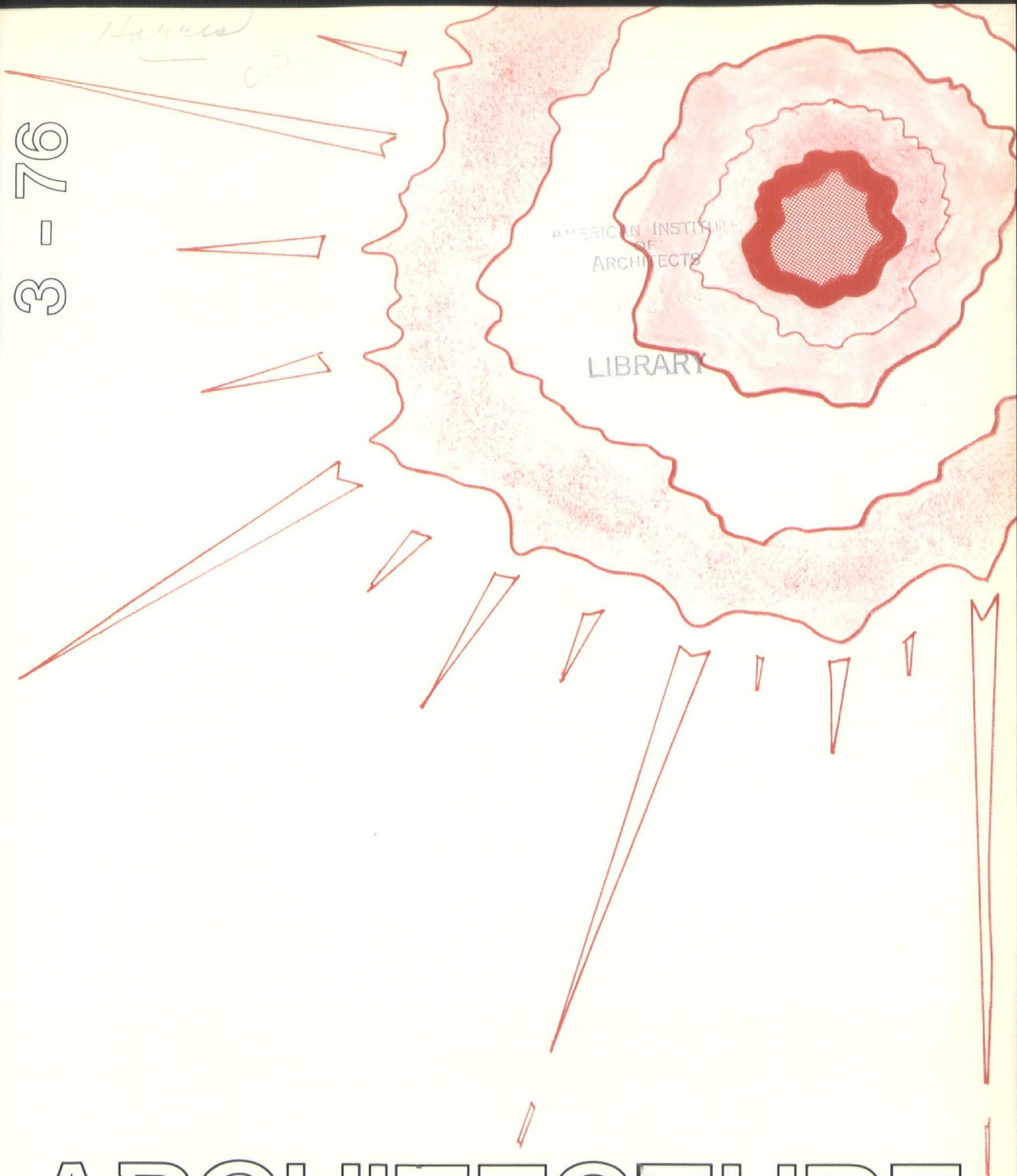

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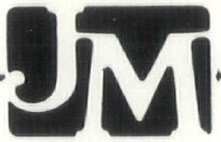

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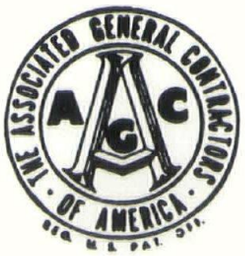

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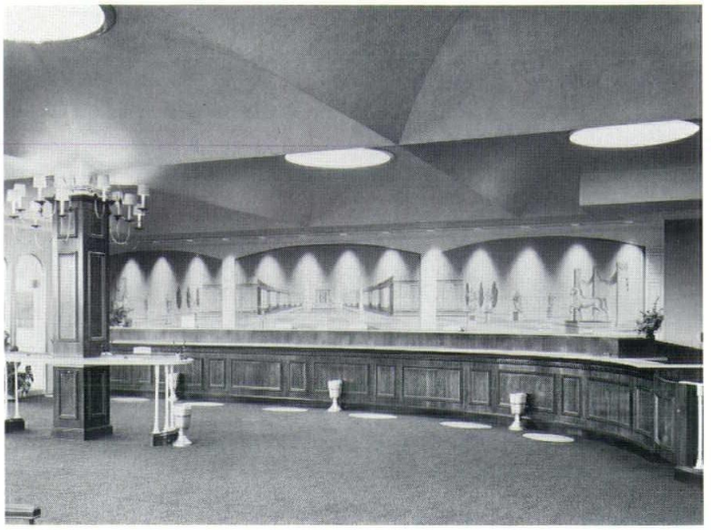

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Short Hills, N.J.

Architect: Abraham Goodman
Linden, N.J.

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ARCHITECTURE
new jersey

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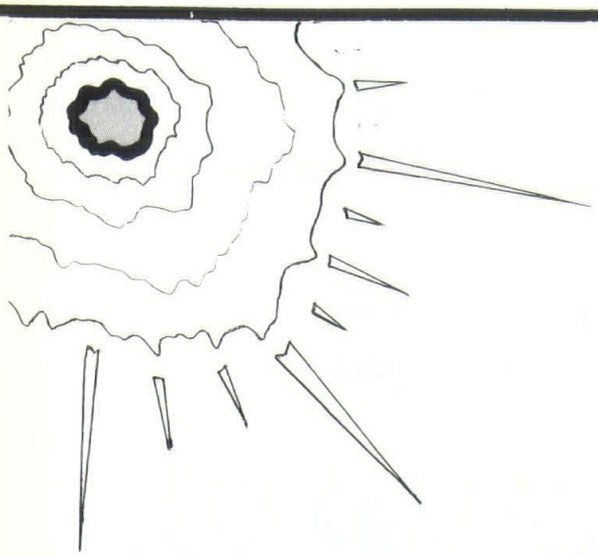
State of The Art

Joseph R. Borda, AIA



For more than two centuries man has endeavored to harness the energy of the sun for technological reasons. These early experiments included French solar furnaces, British irrigation pumping systems on the Nile, and in the early 1900's solar water heaters in Arizona, California and Florida.

It has been estimated that if the sunlight that falls on the earth in a single day could be converted to useful energy forms, it would satisfy the earth's needs for 50 years. If the sunlight that falls on 10% of the desert areas of the Southwestern United States could be utilized, it would answer all of America's predicted energy needs to the year 2000.

Harnessing the energy of the sun is receiving renewed attention in the U.S. as the search for alternate energy sources intensifies. This interest is motivated to some degree by economics, but primarily by governmental action to reduce the U.S. dependence on foreign sources of energy and to forestall the depletion of our own energy resources. The economics of solar energy are not favorable for its rapid development and use at this time. The high initial cost, increased property taxes (added property value), and reliability factors of solar systems will continue to impede its utilization until these economic factors change. This could occur by:

1. Lower cost/highly reliable system components being marketed on a broad scale.
2. Conventional energy cost escalations to the point where solar is more cost effective.
3. Tax incentive or credits are high enough to make it attractive.
4. Availability of conventional energy sources is so limited that solar is needed to make up the shortage.

Since the economic factors must change so dramatically, governmental action seems the most likely motivator for the short term growth of solar energy utilization. (This has begun to occur and is very encouraging.) There are several governmental agencies active in solar energy. The Energy Research and Development Administration (ERDA), the Federal Energy Administration (FEA), the Department of Housing and Urban Development (HUD), and the National Aeronautics and Space Administration (NASA) all have active or planned solar programs that are of special interest to Architects. In addition, many state governments have legislation in various stages dealing with the use of solar energy. Briefly, the objective of all of these programs is to encourage or even accelerate the development and utilization of solar energy to offset the increasing energy demands of our society and to slow the depletion of our exhaustible sources of energy.

At present the designer of solar-augmented HVAC system faces some major hurdles. The completeness and reliability of weather data to determine solar availability leaves a lot to be desired. Unlike designing conventional HVAC systems and selecting components from catalog data, there is no commonly accepted design procedure to be followed. An economic evaluation of first costs and owning costs are very complex and hinge on variables such as utility costs and replacement costs that are not within the designer's ability to control.

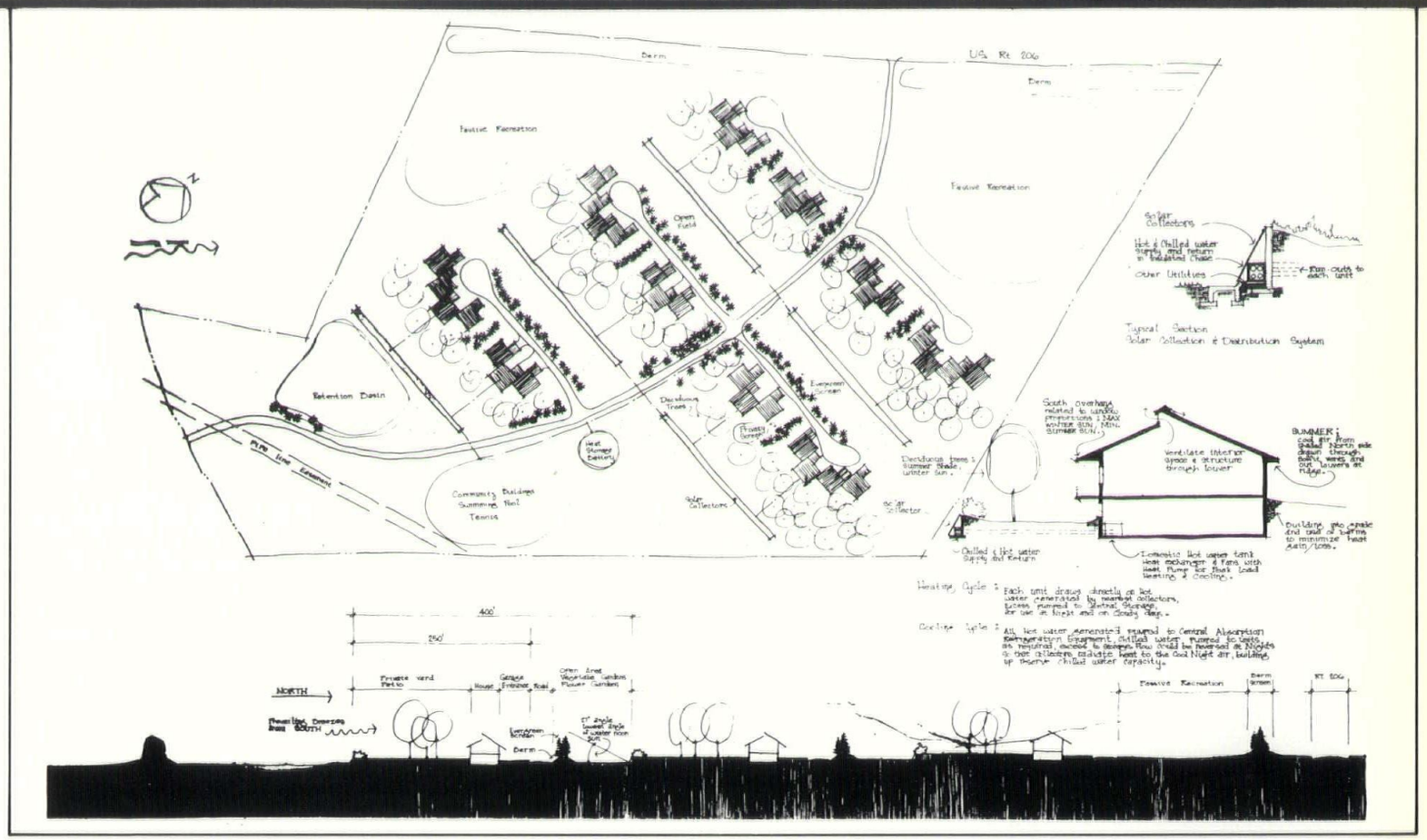
Research has shown some potential areas that are likely to be developed in the future. For example, refrigeration compressors driven by Rankin cycle engines used for cooling or as heat pumps. This Rankin cycle uses a solar heated refrigerant gas as the motive power. Another area of improvement is thermal storage techniques using the heat-of-fusion of different salt hydrates. This approach reduces the size of storage necessary and has potential for reducing cost and enhancing storage capabilities.

NJSA's Energy Task Force activities in solar energy have developed further than information dissemination. Committee members have attended many seminars and visited solar development projects not limited in geography to our own state. We are proud of their efforts and hope to keep you informed in this most interesting area.

Editor's Note: Mr. Borda is Chairman of the Energy Task Force of the N.J. Society of Architects.

The case studies illustrated on the following pages have been compiled by Cassandra A. Carroll, AIA, who also was responsible for the composition of the editorial material.

AIA Research Corp. Project


Berm
US Rt 206
Berm
Passive Recreation
Passive Recreation
Open Field
Retention Basin
Community Building
Swimming Pool
Tennis
Heat Storage Battery
Solar Collectors
Solar Collectors
Deciduous Trees
Evergreen Screen
Deciduous trees
Summer Shade
Winter Sun
Typical Section
Solar Collection & Distribution System
Ventilate interior space & structure through louver
SUMMER:
Building into grade and shade of berms to minimize heat gain/loss.
Chilled & Hot water Supply and Return
Heating Cycle:
Each unit draws directly on hot water generated by nearest collectors, excess pumped to Central Storage for use at night and on cloudy days.
Cooling Cycle:
All hot water generated required to Central Absorption Refrigeration Equipment, chilled water pumped to units as required, excess to storage. Flow could be reversed at Nights & hot cloudy days to waste heat to the Cool Night air, building up reserve chilled water capacity.
400'
250'
NORTH
Private yard Patio
House
Garage Entrance Road
Open Area Vegetable Garden Flower Garden
Passive Recreation
Berm
Rt 206

Credits:
SOLAR CONDOMINIUM
Princeton, N.J.

Architect:
SHORT AND FORD, Princeton, N.J.

Consulting Mechanical Engineers
FLACK and KURTZ, New York, N.Y.

Princeton architects Short and Ford developed the following proposal for a "solar condominium" for submission to the AIA Research Corporation in the fall of 1974. Located on a gentle sloping site in Lawrence Township, the concept is primarily designed to study the application of solar energy principles to clustered attached housing and to challenge the prevailing municipal tendency to legislate against such housing types in areas of low density zoning by creating dwellings which would be supported by a low cost, independent and efficient energy system.

Having previously studied applications of solar energy systems to individual detached homes, Short and Ford identified the following shortcomings associated with such approaches: individual homeowners are most often unable to bear the economic burden of investing in solar collection hardware systems which are quickly rendered obsolete; most individual homeowners lack the technical training necessary to maintain and balance a solar energy collection system properly; the reflection of sunlight in connection with most solar energy collection systems is quite often an annoyance to neighbors, and the devotion of the south wall or roof of an individual house often limits the flexibility of plan, views and ventilation.

With the above objections in mind, the architects developed a proposal for clustered attached housing. As seen in the accompanying drawings, the dwellings have been designed as the passive facets of the solar energy system. The site's grade has been utilized as much as possible to provide natural insulation to the structures' lower levels; deciduous trees provide summer shade for the houses' southern glass walls (permitting winter sunshine to penetrate the fenestration) and the homes' architecture features southern overhanging roofs and louvered openings. The active facets of the system, i.e., the solar collectors, hot and chilled water supply and heat storage battery are centralized and so located on the site to optimumly service the housing. The system's heating cycle consists in each dwelling unit drawing directly upon hot water generated by the nearest collector and pumping the excess to a central storage facility for night and cloudy day use. Its cooling cycle consists in hot water being pumped to centralized absorption refrigeration equipment, chilled water being pumped to the units as required and excess being pumped to a storage unit. Short and Ford feel that their system possesses distinct advantages over individual residential solar energy collection systems: solar energy hardware of greater efficiency and better quality could be more easily designed, purchased and maintained through the pooling of economic resources; greater freedom of room arrangement, window location and landscaping is permitted; the centralization of collectors can result in increased passive solar heat gain because windows, skylights and greenhouses can be more easily placed on the south wall and deciduous trees can be located without fear of shielding the collectors.

ENVIRONMENTAL EDUCATION CENTER

Credits:
SOMERSET COUNTY PARK COMMISSION
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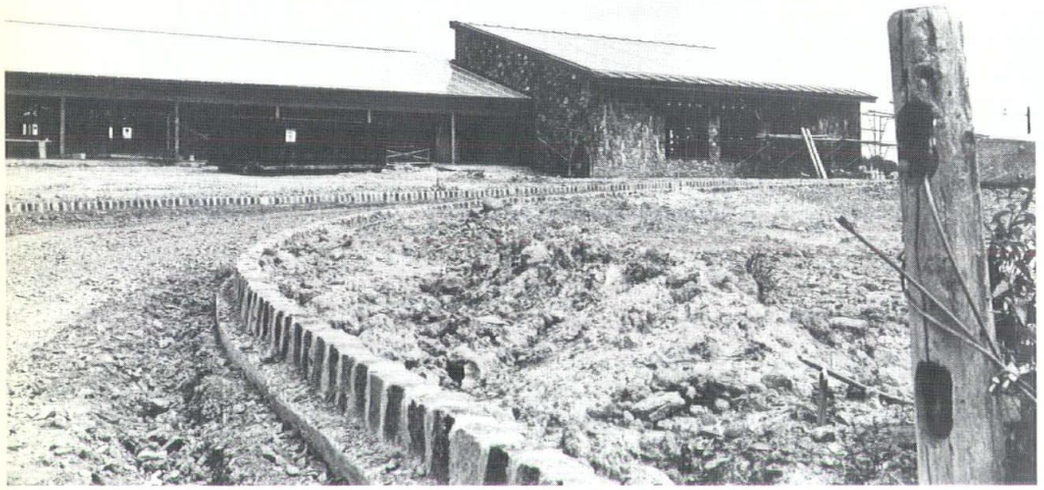
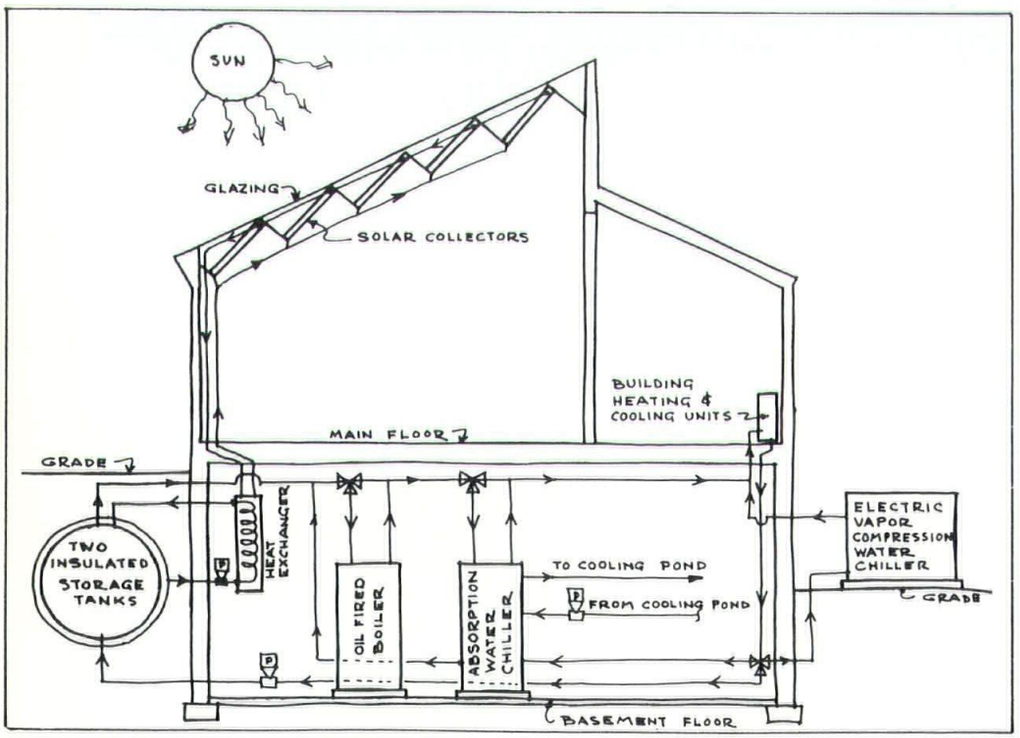
Completion Date: August 1976





"The decision to include a solar energy system in the building was an outgrowth of the planning process we followed after the conception of the building program in 1970." Architects Bill Halsey and Herb Ryder discuss the program as it evolved. "In designing the building, we were aware of the Park Commission's objectives to provide a center where education in the various aspects and interrelationships of our natural environment could be effectively housed and visually symbolized by the structure. We therefore designed a building which would have a minimum visual impact upon its natural setting, utilizing extensively natural materials such as fieldstone and rough sawn wood.

"Subsequent to the design of the building and before we developed our construction drawings and specifications, we were asked by the Chief Naturalist of the Parks Commission to explore the possibility of incorporating some sort of natural energy use in the building to further demonstrate the need for man to make wise use of his natural resources. After investigating many possibilities such as wind power, water power and the use of recycled building materials, we settled on solar heating and cooling as the system that would be most effective in natural energy utilization and the least likely to adversely affect the already designed building. In fact, solar heating and cooling would make a meaningful contribution to the basic premise of our design: that this building need not only house an educational program, but also be an educational experience in itself through its harmony with its natural setting and its capacity to demonstrate a new technology that would help to preserve our environment."

Through the combined efforts of the client, architects and their consultants, an unsolicited proposal was submitted to the Federal Energy Research and Development Administration (ERDA) for funding of this experimental system using solar energy as a resource for heating and cooling, as well as using a near-by pond as a natural cooling pond for the solar activated absorption cooling unit. ERDA accepted the proposal after construction was underway, and partially funded the solar resource aspects of the new building. Among the features of the proposal which contributed to its acceptance are the following:

- The building is of a public nature, devoted to education and the environment, reaching thousands of residents of Somerset County.
- The project was under construction at the time of the proposal and was using the services of local professionals and trades, offering insight into the administrative effects of incorporating this solar energy system into an existing new structure.

— The experimental and comparative nature of the system offered the possibilities of evaluating, monitoring, and comparison of systems.
— Education, documentation and dissemination of the results and benefits of this solar energy system relating to man's environment are included in the basic educational goals of the Environmental Center.

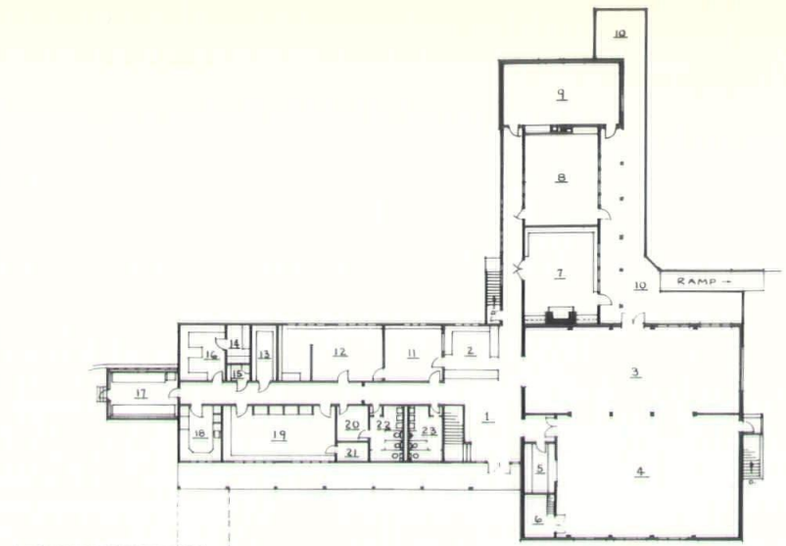
The Environmental Education Center is an 18,000 sq. ft. structure sited in a field between two ponds and a large mulberry tree. Energy conservation in the design is apparent in numerous ways such as roof overhangs for summer shade, the fieldstone mass to hold heat in winter and absorb heat in summer, insulation throughout, operating windows, and the orientation of the structure for sun exposure, prevailing winds and observation of the surrounding wildlife.

The 5,000 sq. ft. of collector area forming the south roof surface absorbs the sun's rays through 2 layers of lexan plastic, heating a solution which is pumped through the aluminium collector panel to an insulated storage tank buried next to the mechanical equipment room. This tank of stored heat is in turn used to heat the coils for the domestic hot water, the coils for the building loop for heating in the winter, and the coils for the absorption cooling unit (works like a kerosene refrigerator) which then send cool water through the building loop for cooling in the summer.

The building is equipped with an oil burner system which alone can heat the entire building in winter, or it can raise the temperature of the solar heated water to the required degree for heating in the winter, or it can raise the temperature of the solar heated water to the required degree for the absorption cooling unit in the summer if necessary.

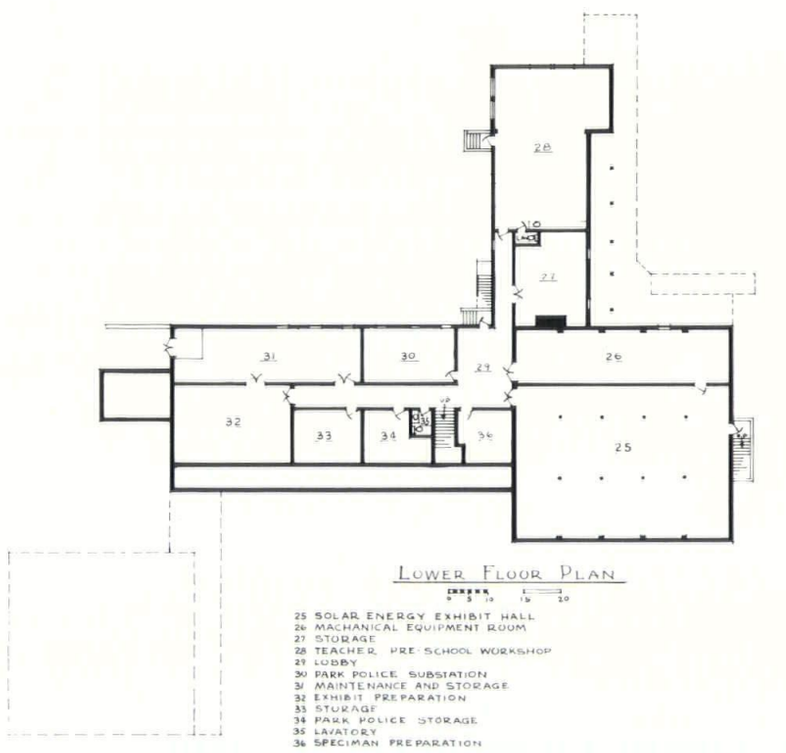
In addition there is an electric evaporative cooling unit (works like a window air conditioner) which can cool the building alone in summer, or can supplement the cooling of the absorption cooling unit. For example, if the solar heated water is not heated to the required degree, the absorption cooling unit may not produce sufficient cooling for the building and cooling will then be supplemented by the electric evaporative cooling unit.

The fascination of this solar energy system lies in its numerous combinations and permutations in each of the cooling or heating modes, as well as the monitoring being carried out by the Chief Naturalist on all the environmental effects. This is a marvelous opportunity for both the professional and the public to become acquainted with the sun as a specific resource for heating and cooling.



MAIN FLOOR PLAN

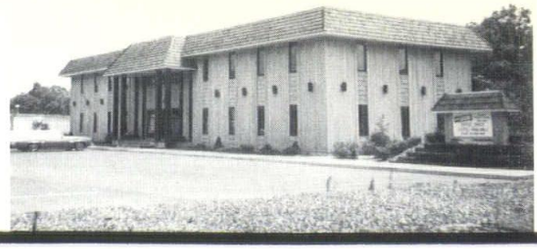
1-RECEPTION
2-SALES AND REGISTRATION
3-EXHIBIT AREA
4-AUDITORIUM
5-KITCHEN
6-CHAIR STORAGE
7-LIBRARY
8-ORIENTATION ROOM NO. 1
9-ORIENTATION ROOM NO. 2
10-OBSERVATION DECK
11-SECRETARY-RECEPTIONIST
12-CHIEF NATURALISTS OFFICE
13-STORAGE
14-DARK ROOM
15-JANITORS CLOSET
16-AUDIO-VISUAL PREPARATION R.
17-GREENHOUSE
18-LABORATORY
19-STAFF OFFICE
20-WOMENS LOUNGE
21-STORAGE
22-WOMENS REST R.
23-MENS REST R.
24-FUTURE PLANETARIUM



LOWER FLOOR PLAN

25 SOLAR ENERGY EXHIBIT HALL
26 MACHANICAL EQUIPMENT ROOM
27 STORAGE
28 TEACHER PRE-SCHOOL WORKSHOP
29 LOBBY
30 PARK POLICE SUBSTATION
31 MAINTENANCE AND STORAGE
32 EXHIBIT PREPARATION
33 STORAGE
34 PARK POLICE STORAGE
35 LAVATORY
36 SPECIMAN PREPARATION

Retro-Fit

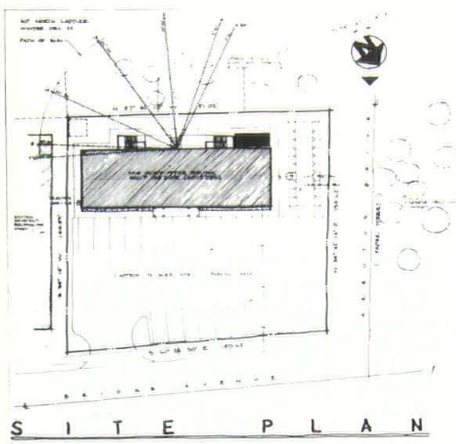


Credits:
COMMERCIAL OFFICE BUILDING
Point Pleasant Boro, N.J.

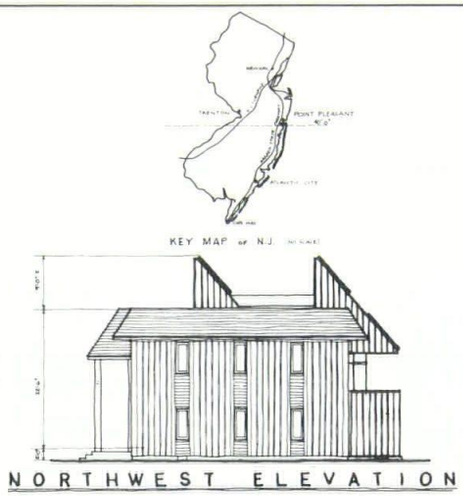
Architects:
BOYKEN, FESSLER & COOK
Holmdel, N.J.

Engineers:
MORRISON, ZIMMER, BORTON & O'CONNOR
Union, N.J.

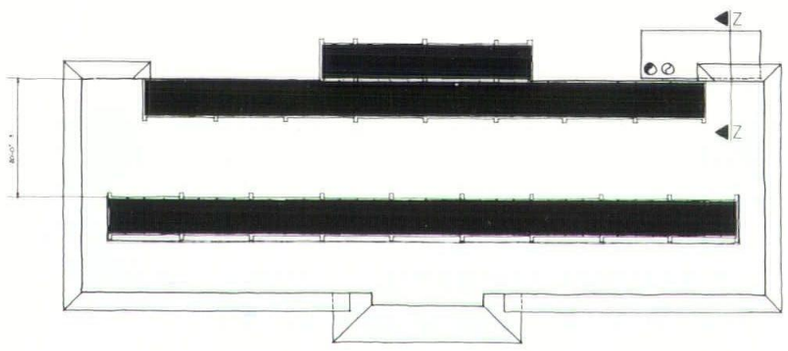
Instrumentation:
MARSHALL R. BOGGIO
Point Pleasant Boro, N.J.



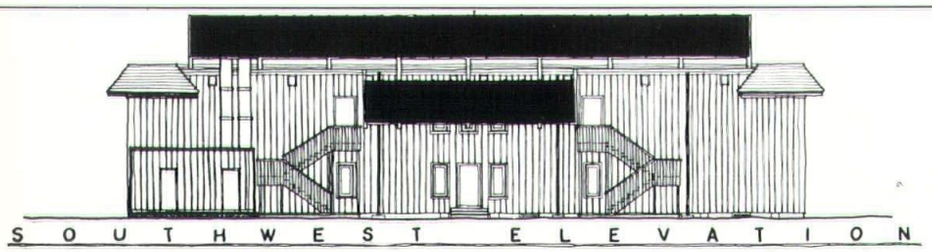
SITE PLAN



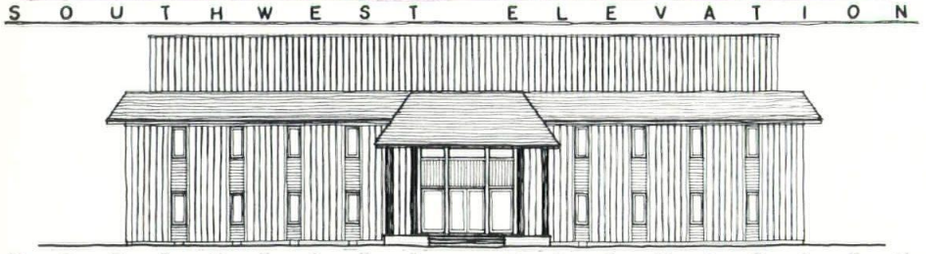
NORTHWEST ELEVATION



ROOF PLAN



SOUTHWEST ELEVATION



NORTHEAST ELEVATION

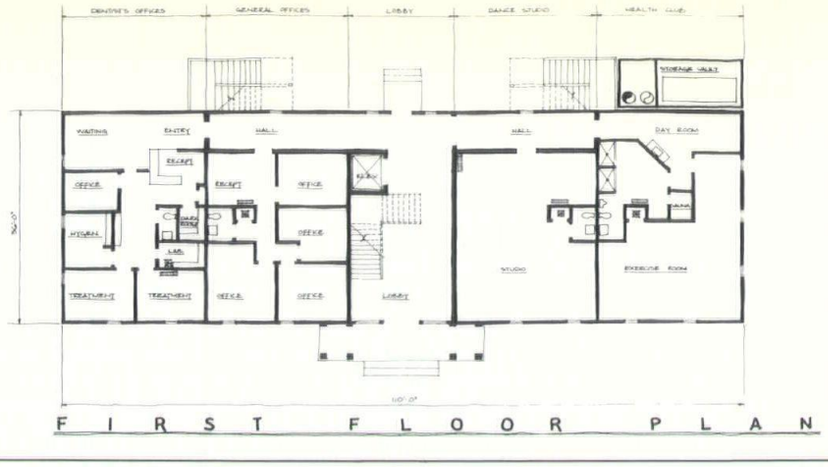
The Architect's design charge was to retro-fit an existing two-story, 4,000 sq. ft., commercial office building with a solar system. The system would be designed to assist the present conventional air to air electric heat pump system, the primary source for space heating, and would also provide minimal domestic hot water heating requirements. It was this design team's hope that should such a retro-fit system prove successful, it would have wide application in similar commercial structures initially oriented to economy rather than to long range pay-back.

The very nature "retro-fit" forced the team to cope with some inherent basic problems, such as the existing conditions of both the site and building construction. Trade-offs had to be made to achieve the maximum performance of the solar system.

The Architect states: "It was evident to us, very early, that the collector orientation would be one of our most difficult problems. Our site was small, and zoning ordinances placed numerous difficult restrictions on the project. Specifically, the ordinances, along with certain other site restrictions, precluded our early thinking that we could create a collector farm adjacent to the building. Regardless of the added superimposed loading conditions, the most logical area to place the collectors became the existing roof. The height allowed the collectors to be unobstructed in the sun's path, placing them above the surrounding structures and vegetation. Shadow patterns of the collectors were studied and became the governing criteria in determining their lateral positioning. By virtue of the studies we found there was simply insufficient space to mount the collectors on the roof within the optimum orientation $\phi f \pm 20^{\circ}$ off south and still maintain unencumbered exposure to the winter sun (ie: mounted diagonally across the building in separate banks). We compromised by orientating the collectors parallel with the length of the building (facing approximately 34° west of south) and provided additional collector area to compensate for the anticipated solar insolation losses."

"Air was selected as the transfer medium primarily because this type collector afforded the least amount of maintenance, and because forced air was used for the existing primary heating-cooling system. Secondly, there would be appreciably less additional weight superimposed on the existing roof structure than there would be with water type collectors. In addition, air has desirable heat transfer properties when used for exchange in the rock storage medium we selected."

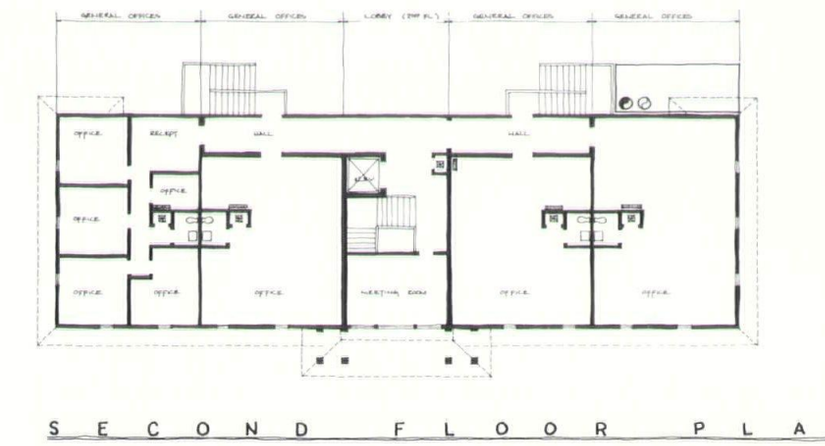
"Storing the heat became our next problem. There was no space within the confines of the building, to construct a heat storage chamber.



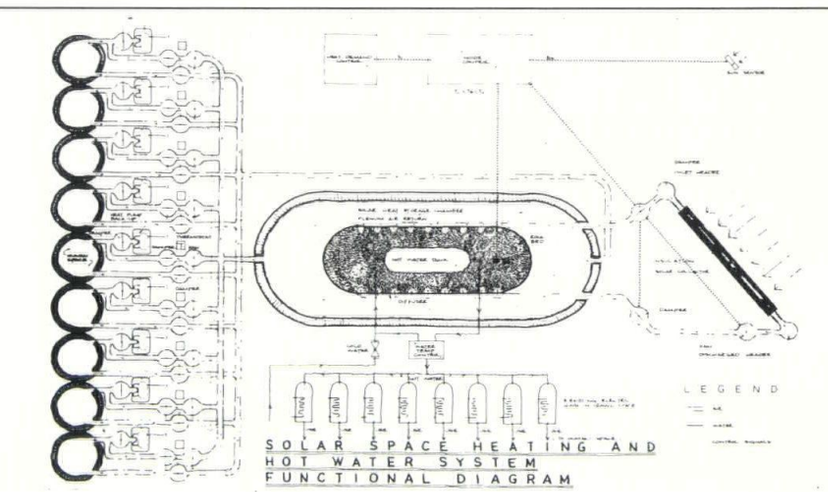
FIRST FLOOR PLAN

We wanted to create a space that could be easily and quickly constructed and one to which we could gain ready access for monitoring purposes. A heavily-insulated enclosure (similar to that used for walk-in refrigerators) became the obvious answer for our rock bed heat storage chamber. Again, primarily due to zoning restrictions, we were forced into a selective compromise. We had to limit our storage chamber area. We chose, therefore, to consider the basic energy cycle as 24 hours and sized our chamber on that premise. The team didn't feel this limt would be detrimental as it related to the daily space heating requirements of the building."

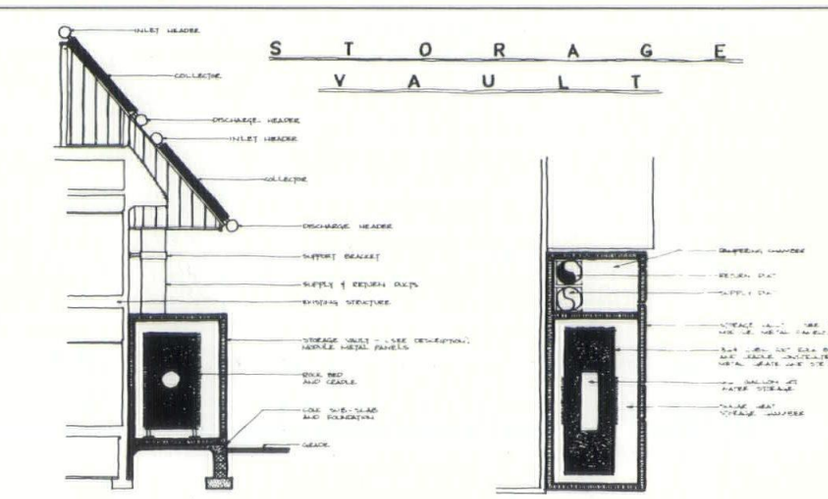
Delivery of the collected heat from the 1,500 sq. ft. of roof mounted collectors to the storage chamber is performed by a utility fan capable of 4300 cfm air flow. As heat is collected in the chamber, that heat required for the daily needs of the human spaces (i.e. the normal 8 hour working day) is routed into the existing air duct system for each tenant suite. Simultaneously, as excess heat is accumulated, it is stored in the rock bed for use in the remaining 16 hours of the heating cycle as well as heating the domestic hot water. Reduced night time thermostat settings allow sufficient heat to remain for the start of the next 24 hour cycle. When there is insufficient heat available from the solar system and the rock storage bed, the space heating needs are supplemented by the existing conventional system which is designed to heat the entire building in the absence of solar assistance.



SECOND FLOOR PLAN



SOLAR SPACE HEATING AND HOT WATER SYSTEM FUNCTIONAL DIAGRAM



STORAGE VAULT

Exploiting The Site

Credits:
RENOVATION AND ADDITION TO PRIVATE RESIDENCE
Hopatcong Borough, N.J.

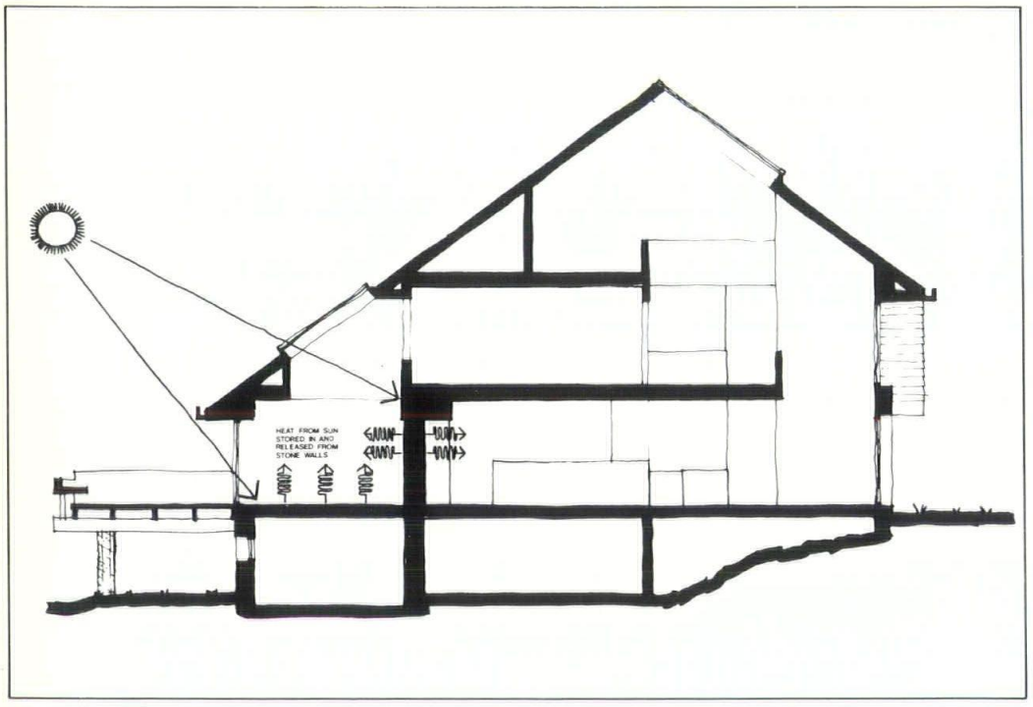
Architect:
TERRY PARKER, AIA
Montclair, N.J.

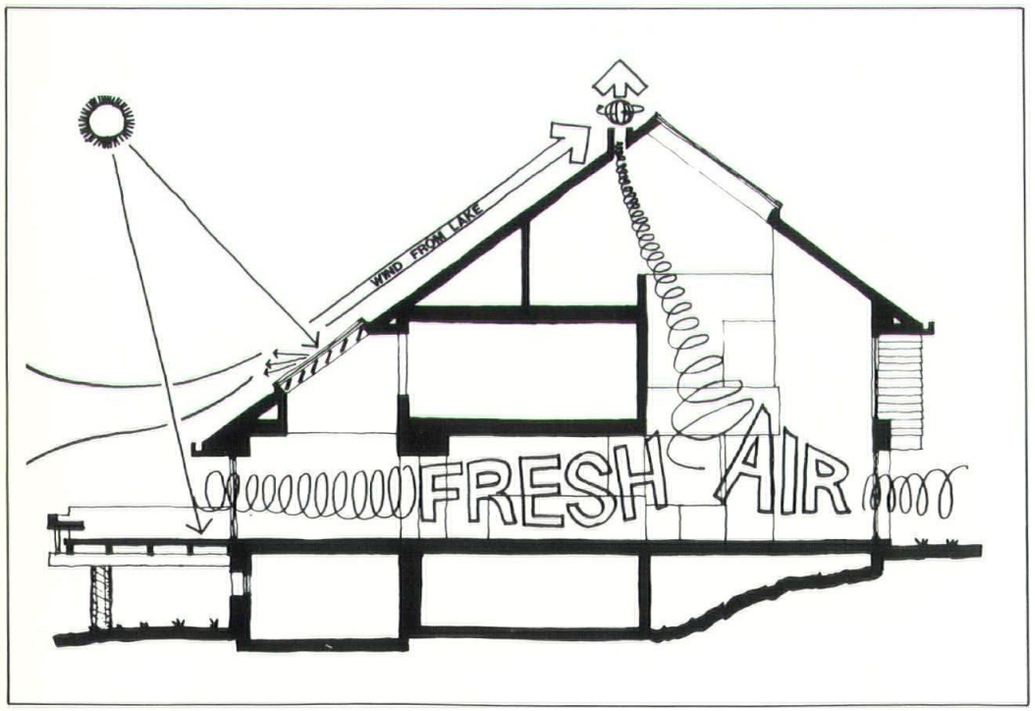
Solar Consultant:
FRED KOOP
Somerville, N.J.

Structural Consultant:
NACAMULI ASSOCIATES
New York, N.Y.

Interior Design:
CAROL SIEGLER
Lake Hopatcong, N.J.

Completion Date: August 1976





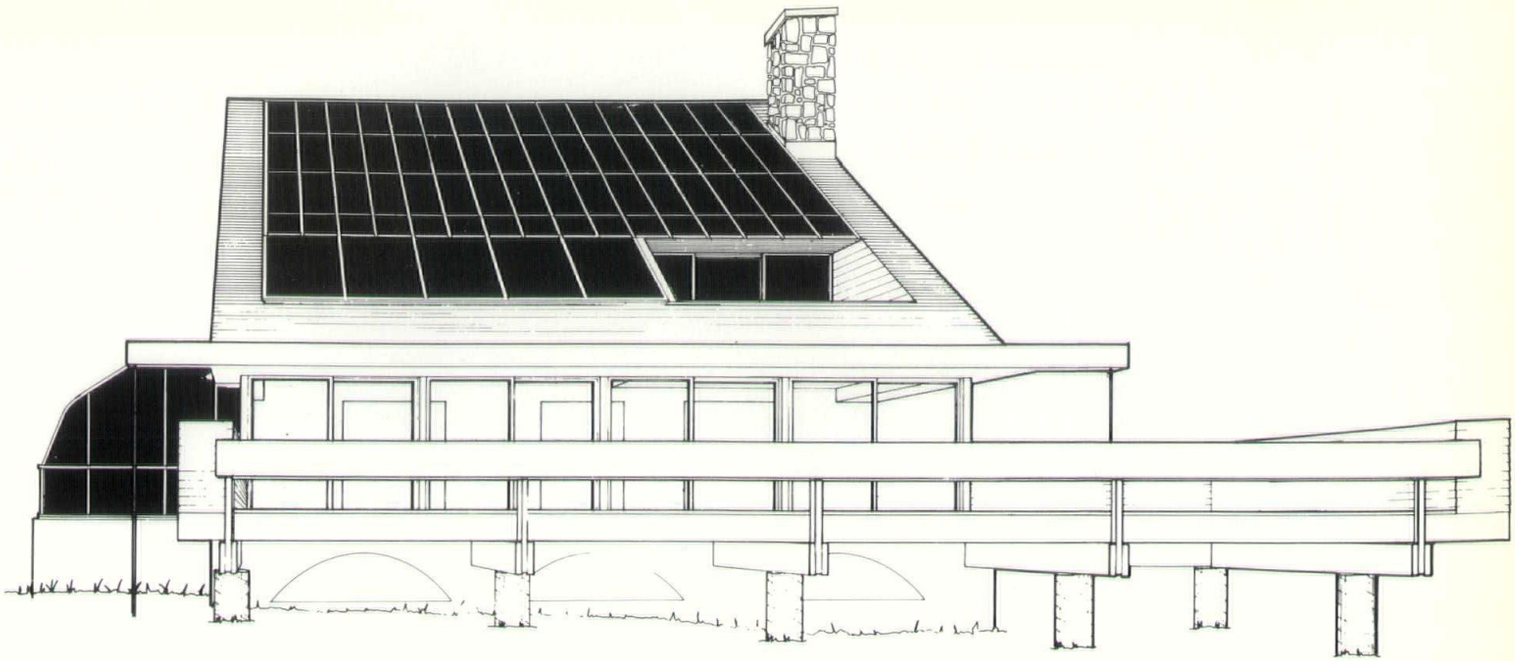
"The first step in using solar energy is mandatory energy conservation." Architect Terry Parker adds that "Buildings should be as natural as sailing ships, in partnership with nature. Most of the buildings of the last fifty years violate this relationship and use energy, primarily in artificial lighting and air conditioning, to overcome their shortcomings.

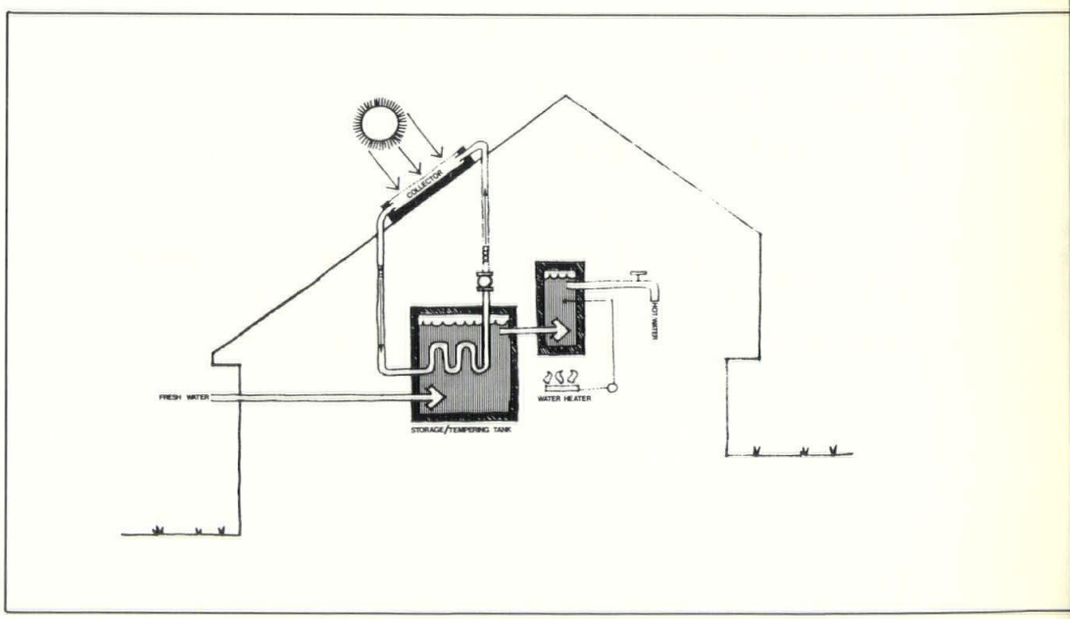
"This house is designed for maximum energy conservation," and he goes on to explain that "windows are the most efficient and least costly solar collectors, and will provide natural ventilation wherever possible. The roof overhang allows the winter sun in through the windows and cuts out the summer sun. All the windows and the sliding glass doors are triple glazed and the house has full, thick, foamed-in insulation to minimize the heat losses and gains."

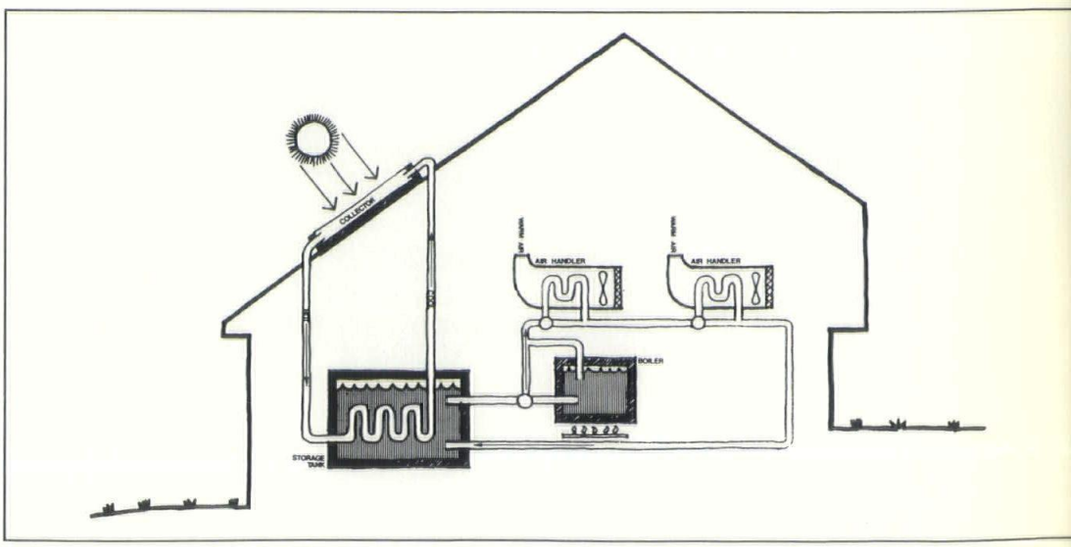
In this 5,000 sq. ft. residence and boat house the use of prevailing winds from across the lake during the summer in conjunction with direct solar radiation increases the natural ventilation of the building. Wind blown turbine fans are located at the top of a 35-foot high space. Breezes from the lake increase in speed as they rise up the steep slope of the roof, aided by being heated by re-radiated solar energy; this higher speed air turns the turbines more briskly, thus drawing more air through the building.

During the winter solar radiation incident on the house is amplified by reflection of the sun's rays off the lake. During the summer the increased altitude of the sun directs reflected radiation above the roof.

There are two initially installed passive solar collectors, an insulated skylight over the dining room (12 ft. x 20 ft.), and a greenhouse (10 ft. x 25 ft.). During the winter the heat that comes through the skylight is absorbed in the fourteen-inch thick stone wall and the eight-inch thick tile and concrete slab of the dining room to be re-radiated in the evening. The greenhouse stores the excess radiation in its earthen floor and the fourteen-inch thick stone wall. During the summer, external aluminum blinds keep excess radiation out of the greenhouse and silvered mylar venetian blinds reflect maximum radiation out through the dining room skylight. The house will accommodate solar domestic hot water. The bathroom and shower in the boat house will have only solar hot water, and a tempering tank allows the very cold well water to heat up close to room temperature before it goes through the hot water heater.







The building is designed to accommodate the future addition of solar collectors when their performance and efficiency increase and their costs decrease. To that end the design, as constructed, allows the future addition of the collection system without any additional cost to the existing system.

CONSERVATION

Credits:
HANOVER OFFICE BUILDING
Hanover, N.J.

Architects-Planners:
ROTHE-JOHNSON
Edison, N.J.

Mechanical/Electrical Engineers:
LESLIE S. STERLING P.E., INC.
Closter, N.J.

Owner:
SUTMAN ASSOCIATES
Edison, N.J.

Design objectives desired by both Architects and Client were to create an economical office building which would incorporate techniques of energy conservation wherever possible.

To meet these objectives the Architects sough a building form which would:

a) provide a large interior, and
b) result in a reduced building perimeter and reduced amount of exterior glass.

The result was a nearly square shape (180' x 200') two-story structure which contained 65,000 sq. ft.

The shape of the building produced the desired ratio of large interior space to a minimum of building perimeter.

In addition the Architects designed a poured-in-place concrete structural system which would provide, at a minimum of additional cost, a cantilevered five-foot overhang which would serve as the building's sunscreen and reduce air conditioning loads.

Using the building form as a base, the Architects, working with their Consulting Engineers, designed a building mechanical/electrical system which would reclaim the internal heat generated within the large interior zone of the building structure (such sources as people, lights, equipment) and utilize the generated heat as an energy source. (See Building Floor Plan.)

Based upon the fact that oil and electricity are presently the only fuels available in New Jersey and the Client's requirements of a low initial cost system which would also provide maximum rentable space, the use of an all-electric HVAC concept was established and a Closed Loop Heat Pump system selected.

Application for Solar Heating

The Closed Loop Heat Pump system can be adapted for solar heating at a future date when the high initial costs of solar heating equipment become more economically feasible for application to the speculative office building type. Obviously if electrical rates continue to increase, owning and operating costs for solar heating equipment will become more favorable.

Energy Conservation

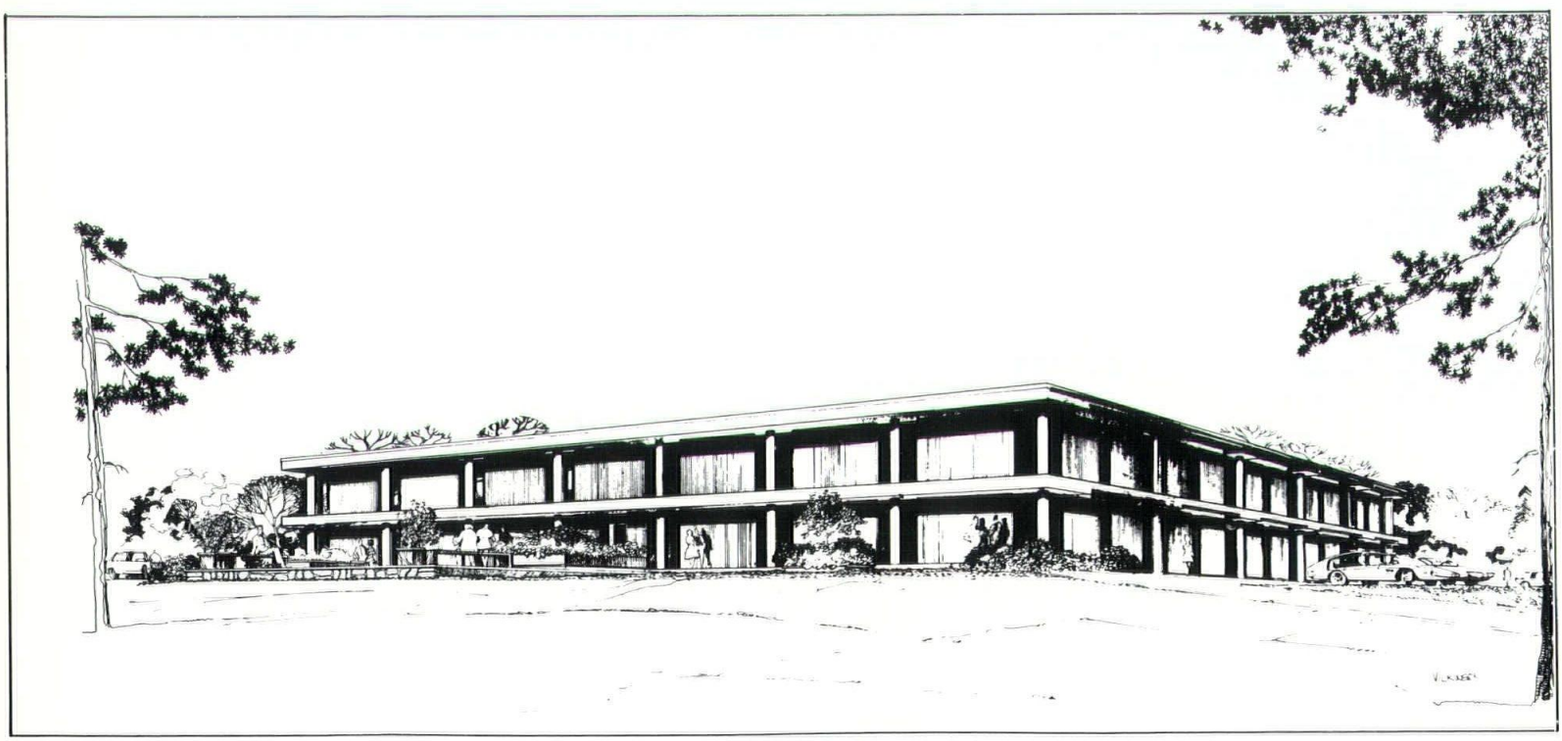
For the present, however, the heat pump system will materially reduce operating costs through energy conservation by transferring internal heat gains within the interior zones to the building perimeter zones. Additional energy conservation is achieved through the use of a roof-top rotary heat exchanger which extracts heat from all the building's exhaust air and pre-heats all incoming ventilation air. (See Diagrammatic Section.)

Operation

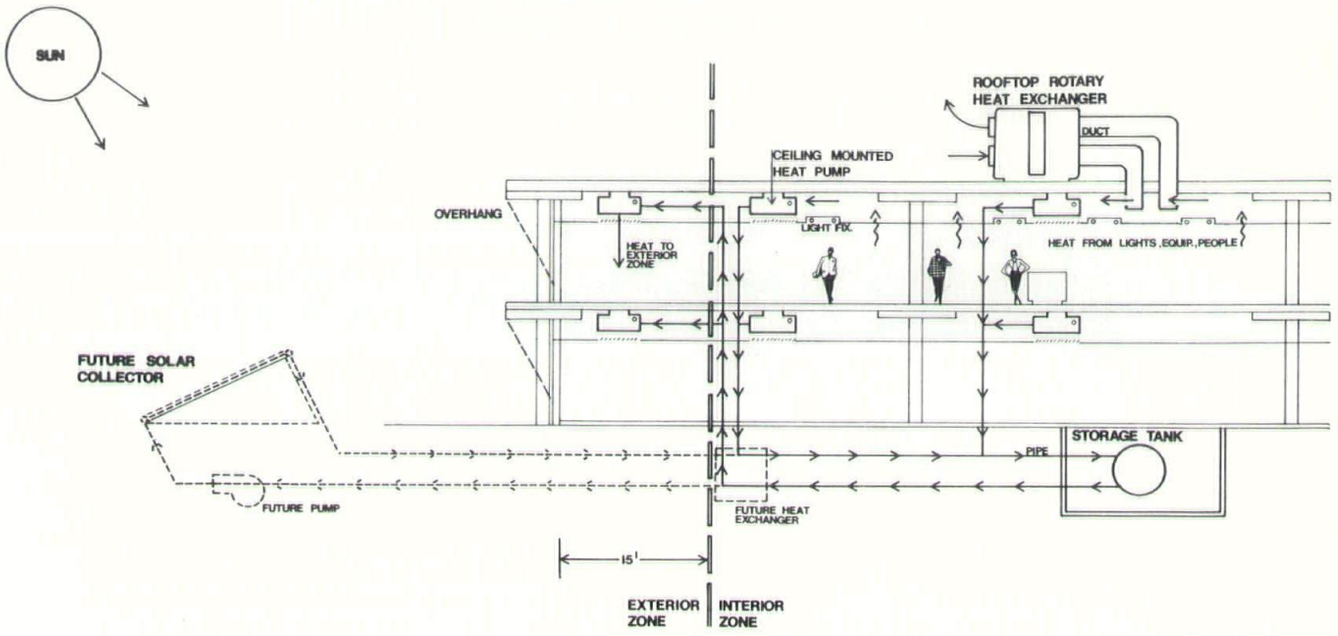
The Closed Loop Heat Pump system has water source heat pumps that operate as air conditioners in the cooling mode. The circulating water flows through the condenser circuit and picks up building heat which is rejected to the outdoors through an evaporative cooler. (Cooling mode not illustrated in Diagrammatic Section.) During the heating mode, the units operate as heat pumps, removing the heat from the circulating water system piping and supplying warm air to the building.

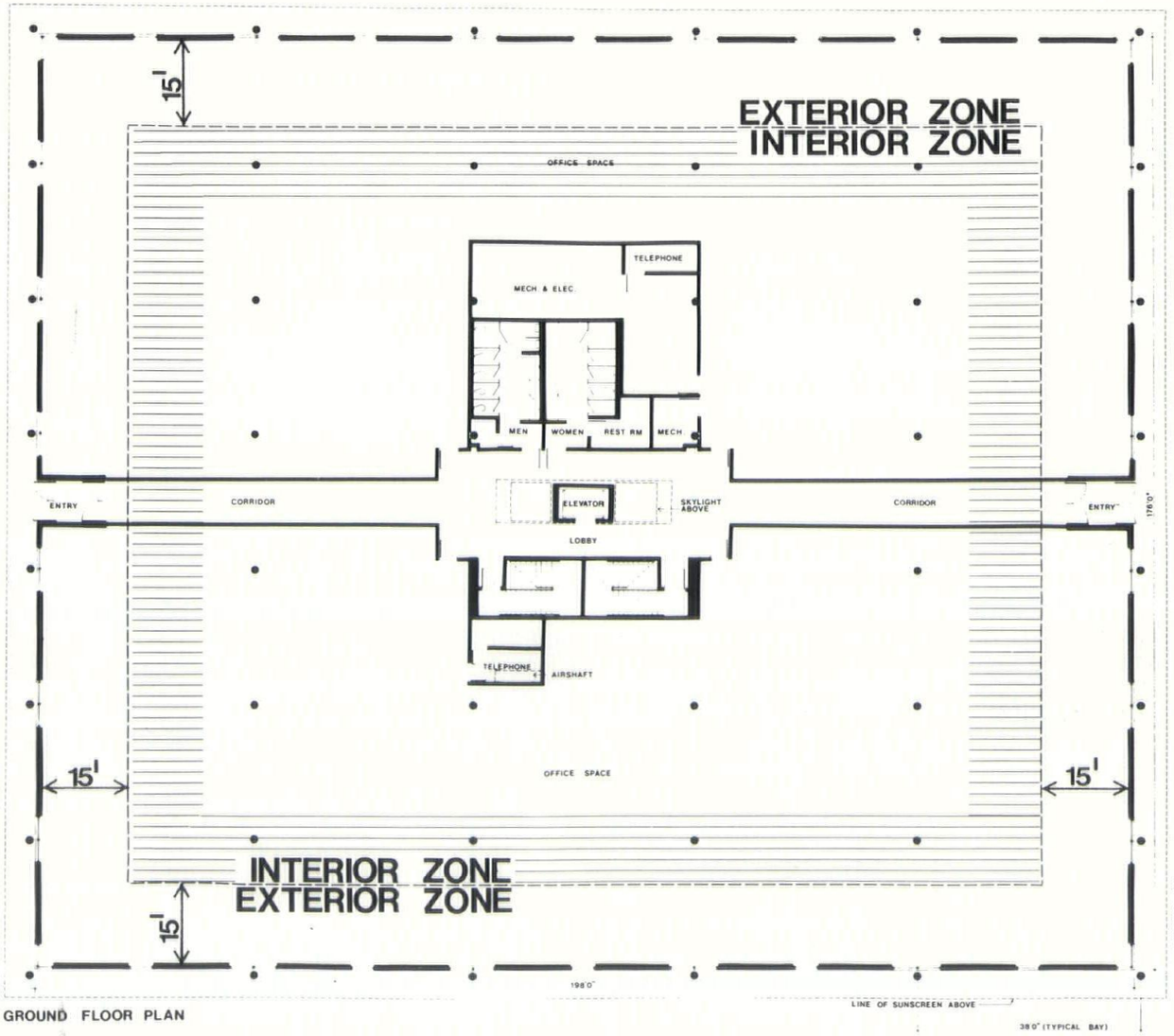
Other advantages of the system include:

- Ability to heat one zone while cooling another
- Flexibility of zoning
- Smaller equipment rooms on each floor
- Quietness of operation

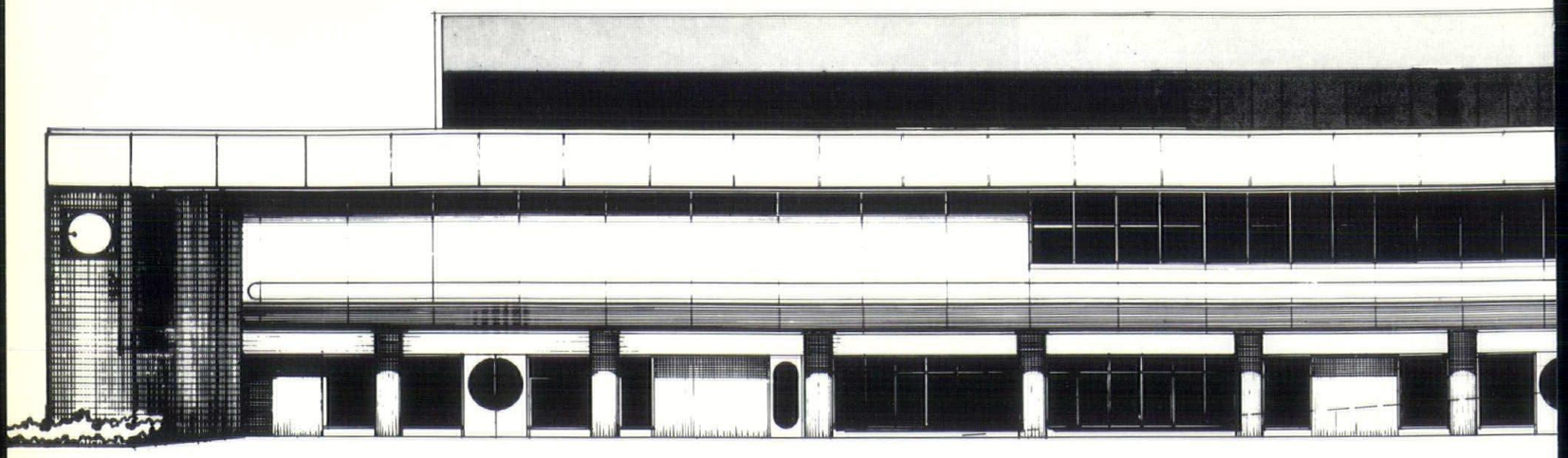


DIAGRAMMATIC SECTION:
BUILDING HEATING SYSTEM





GROUND FLOOR PLAN



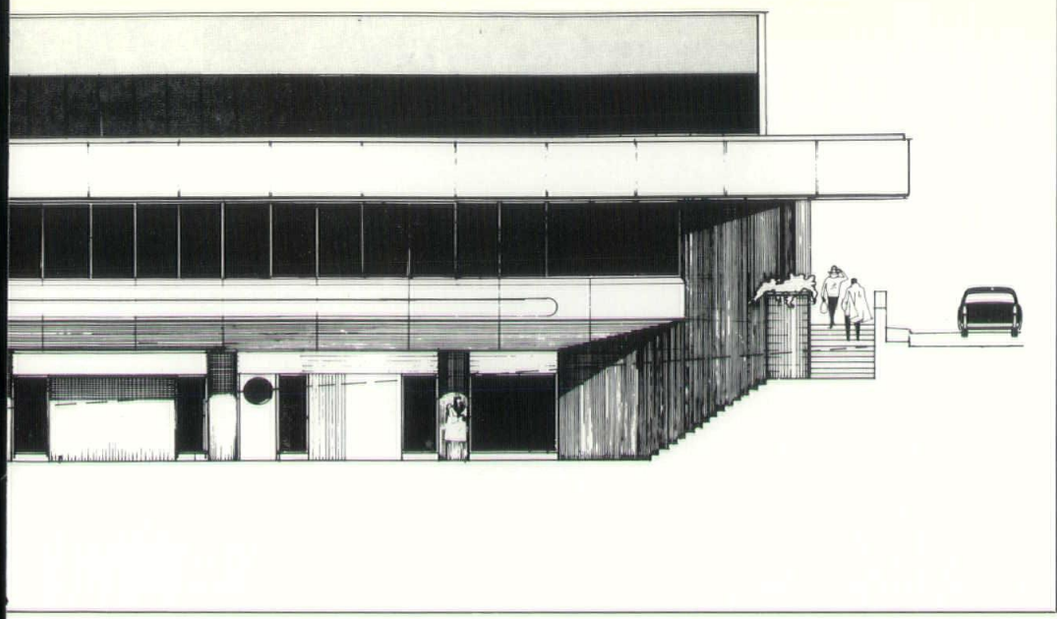
The energy requirements for retail store and shopping centers have traditionally accounted for 4% of the total energy output in the entire country. Here is a look at how some of this energy can be saved by using the sun as a resource to provide heat and light.

An analysis of the loads in energy on a retail building are very revealing. Most of the energy use is dictated by the way we design the buildings rather than by nature's demands. The largest use of energy in a retail store is for artificial light. In a supermarket, where almost 60% of the energy is used for refrigeration, artificial lights typically use another 19% of the energy. Heating and air conditioning use about 11%. When the inefficiencies in the lighting system are taken into account, they add up to one-third of the air conditioning load. More than 22% of a supermarket's energy needs are a direct result of the lighting system. Deducting the refrigeration needs of a supermarket would give a good idea of the requirements of the ordinary retail unit. By that measure more than two-thirds of the energy requirements are due to artificial lighting. The second greatest load in the design of the heating and ventilating (HVAC) system is due to fresh air make-up. These loads are a result of code requirements whose relationship to actual needs is questionable. In this building, one-third of the system capacity is for tempering outside air.

Given the loads due to lighting and fresh air intake, it is questionable whether added insulation would have the expected impact on building loads. Cooling loads are considered to be due to lighting, humidity control, population, solar radiation, and fresh air make-up. Heating loads are considered to be due to heat loss and fresh air make-up. It is strange that the heat of the lights is not even considered in most installations as a source of heat during the winter, although they are considered a heat source on cooling loads during the summer. Energy conservation takes the heat of the light fixtures, captured above the ceiling to heat the storage areas in winter. In summer this heat is exhausted from the building.

Let us now take a look at the energy conservation skylight. Even though high efficiency light fixtures are used in these stores, if one-fifth of the square foot floor area were devoted to skylights an immediate energy savings could be realized. These skylights alone will maintain 100-foot candles for about 50% of the daylight hours, and a percentage of that amount during the rest of the day. Therefore during daylight hours, particularly on those days when there is a maximum load on the system for cooling due to bright sun and high temperature, there will be no lighting load at all. The solar skylight system works in conjunction with a computerized lighting system controlled by a mini-computer. This control system provides only that portion of the additional lighting needed to supplement day lighting, to maintain 100-foot candles. The direct rays of the sun are never allowed into the building as the skylights are shielded by the collectors which run the air conditioning. (See illustration.)

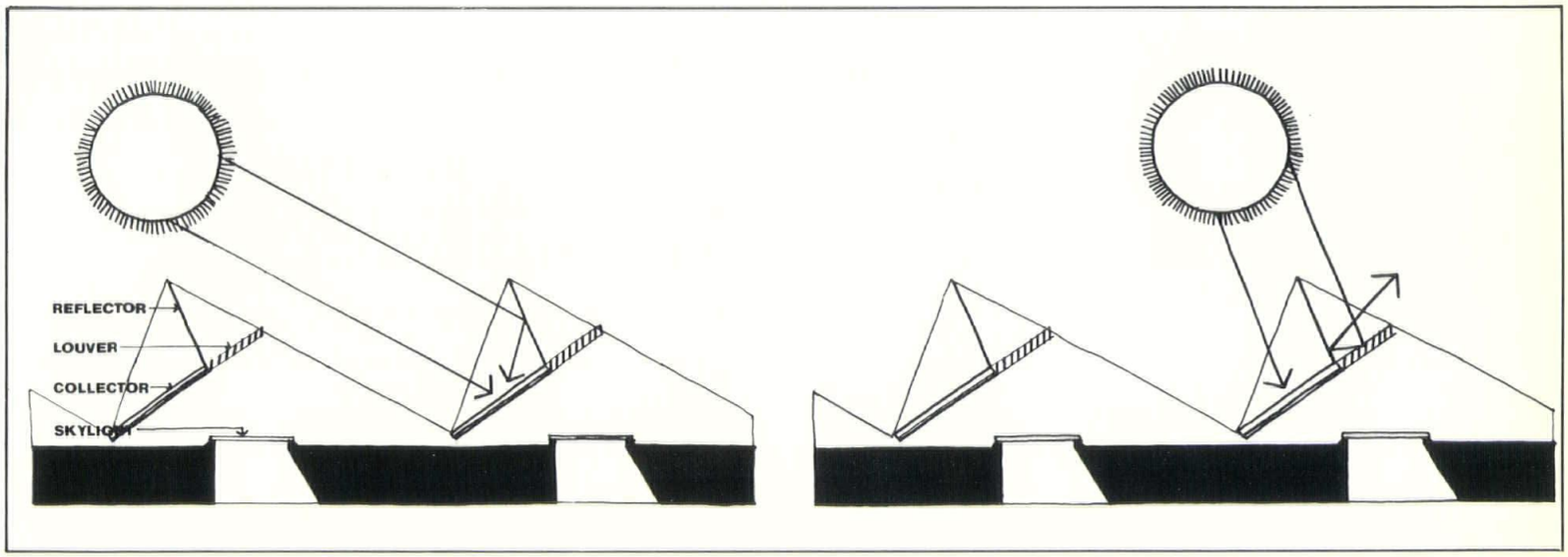
Solar cooling makes more sense than solar heating since the amount of solar radiation that can be collected increases as the load increases, whereas the heating load increases as the solar radiation decreases. Pre-cooled air is first collected under the refrigerated display cases and returned to the air handler. The first 35 tons of air conditioning are provided in this way. The solar cooling system uses an absorption unit to produce chilled water with auxillary energy provided by a steam boiler. During the heating cycle the hot water from the solar collectors is directed through coils in the air handlers with back-up heat provided by the same oil boiler. The solar collectors are fitted with reflective surfaces which serve to boost the collector performance during the winter when the solar radiation is less than during the summer. (The system needs no boost in the summer.) In this manner both the amount of radiation and the temperature are increased.

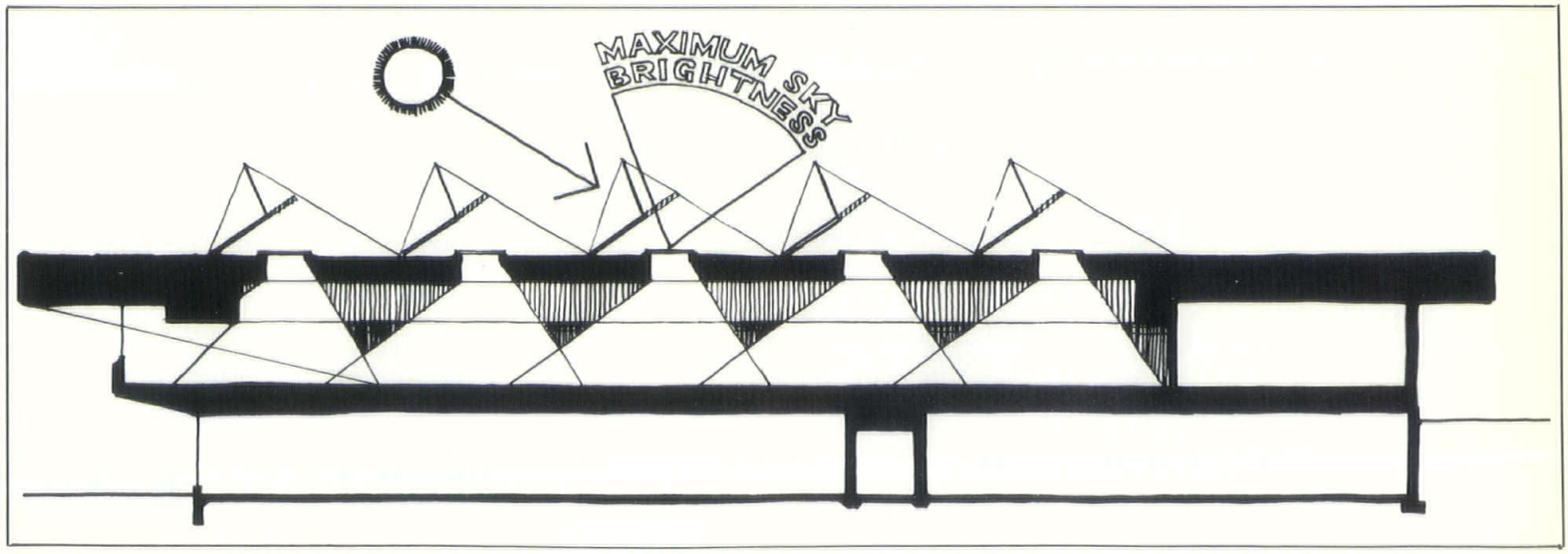


Skylight

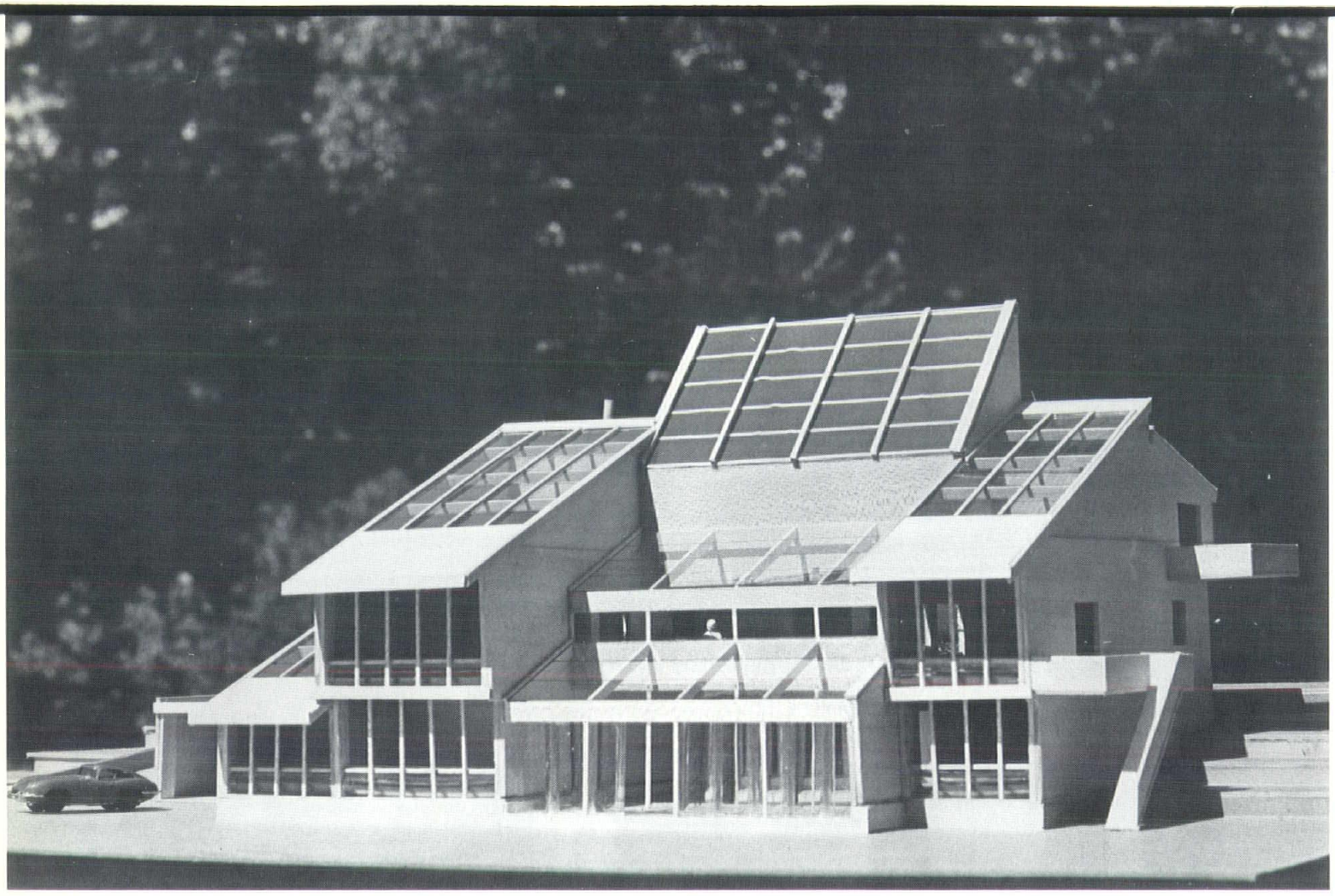
Credits:
MORRIS MALL SHOPPING CENTER
Morristown, N.J.

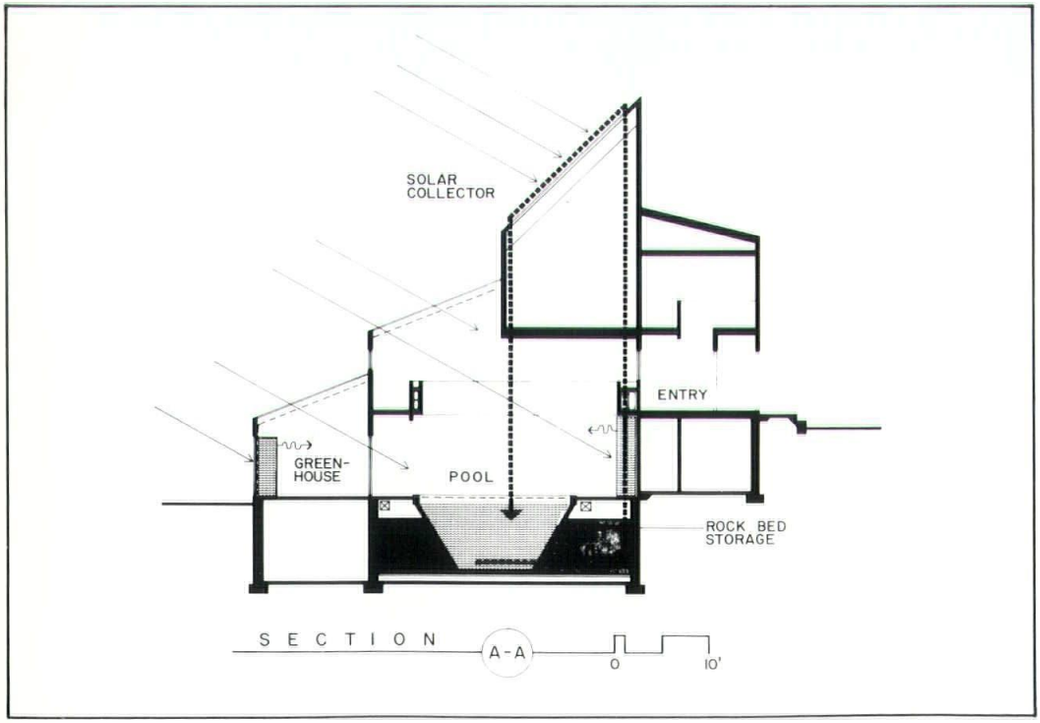
Architect:
TERRY PARKER, AIA
Montclair, N.J.





Active/Passive Residence





Credits:
WASSERMAN RESIDENCE
Westtown, N.Y.

Architect:
ALAN SPECTOR, AIA
Hamburg, N.J.

Solar Consultant:
SUNVERT SYSTEMS, INC.
Vernon, N.J.

Completion Date: Fall 1976

Architect Alan Spector and his client, Kurt Wasserman, publisher of "Solar Age" magazine, are working out the last details for this new solar heated residence, presently under construction on a wooded site sloping down to the south. In this 4,200 square foot home the sun shines directly on a solar heated swimming pool and greenhouse, about which the house revolves; not only setting the pace in design, but also acting as the major radiant heat source for the entire building and the domestic hot water system.

In addition, the pool will store heat for transfer to an air duct system in the winter. In the summer, this open central core acts like a chimney

to draw cool air through the building and out at the top. A well on the property will provide constant 54 degree water to a coil over which air is blown and then distributed to the air duct system for additional cooling.

Supplementary solar systems to augment the pool and greenhouse include "sky-therm north" thermoponds of water at ceiling level which are exposed to the sun's heat during the day in winter, and shielded at night to radiate that stored heat directly into the rooms. One fireplace and two wood-burning stoves are designed for both beauty and as supplementary heat sources. In addition, there are also direct solar heated water drums in the south facade.

This home with its variety of systems working in concert is not planned with any oil, gas or electric back-up heating or cooling system. Mr. Wasserman is confident of his research and is presently refining the details of his personally engineered solar collector panel for direct heating of the pool water. Maintenance of the systems is planned to be minimal because of their simplicity, and the inclusion of silica gel panels in the air duct system is designed to alleviate any moisture problems inherent with an indoor pool.

Architect Alan Spector states that "When we began designing this solar heated home, we originally chose an active water system consisting of an array of more than 1500 square feet of flat plate solar collectors.

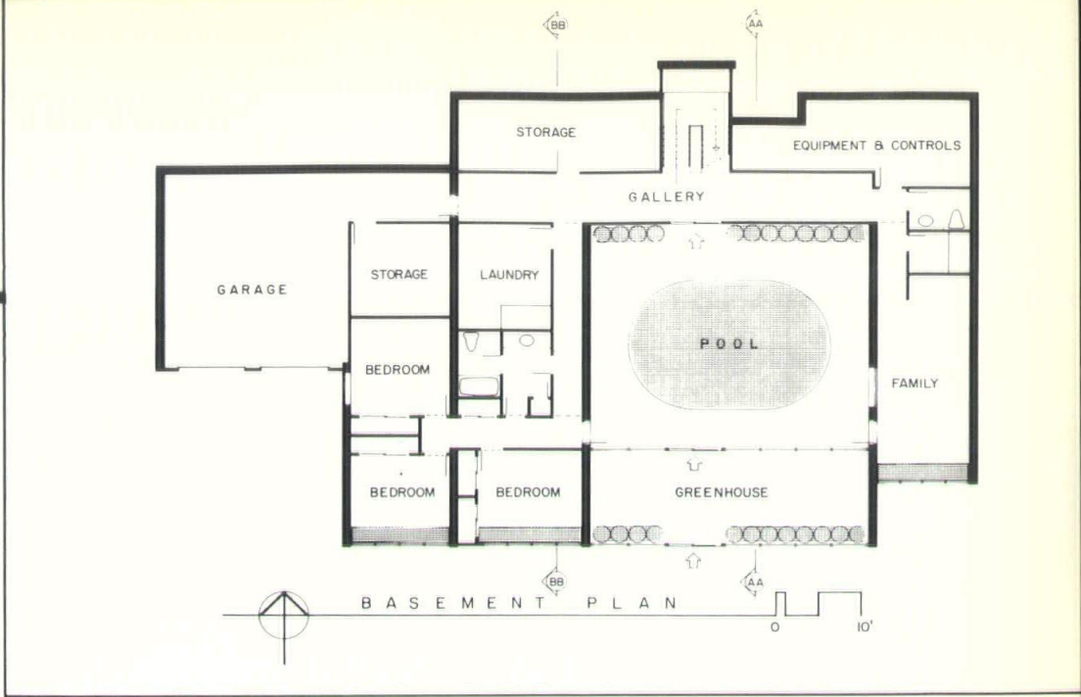
After much research, it became apparent that this active solar system was too restrictive, since it was totally dependent on very expensive collectors, and a complicated mechanical distribution system. In addition, this active system restricted design flexibility since the collectors dictated a very steep roof pitch.

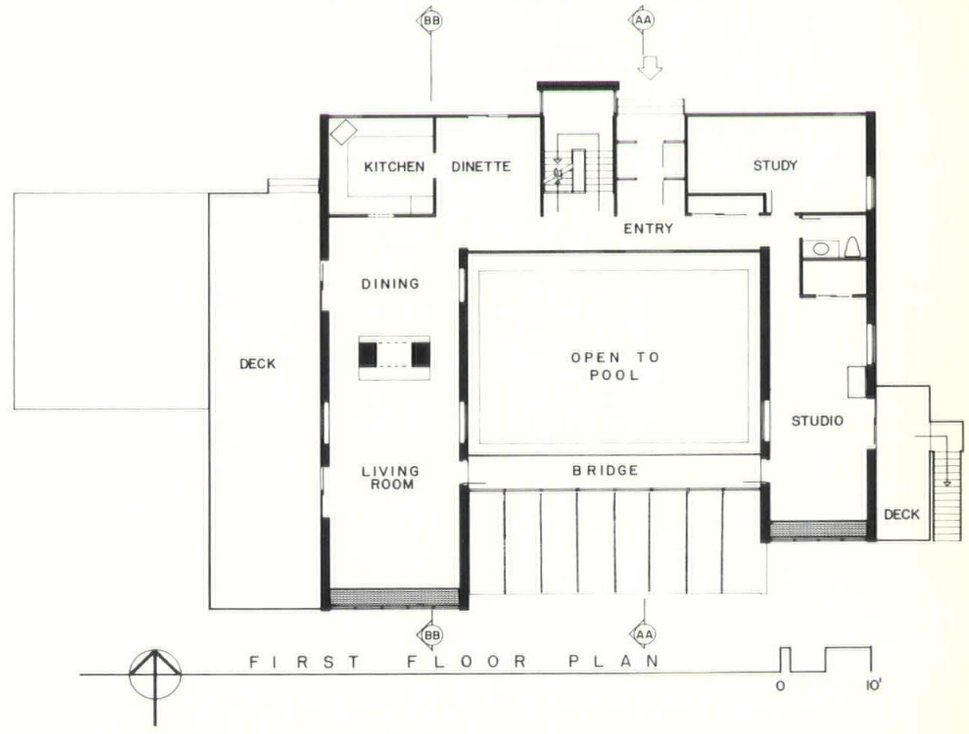
The present design derives a solar advantage from a more passive solar system, which makes greater use of direct solar heating. Of primary importance in this passive approach are careful orientation, increased insulation throughout the building, and maximum use of the spaces themselves to collect and store solar energy.

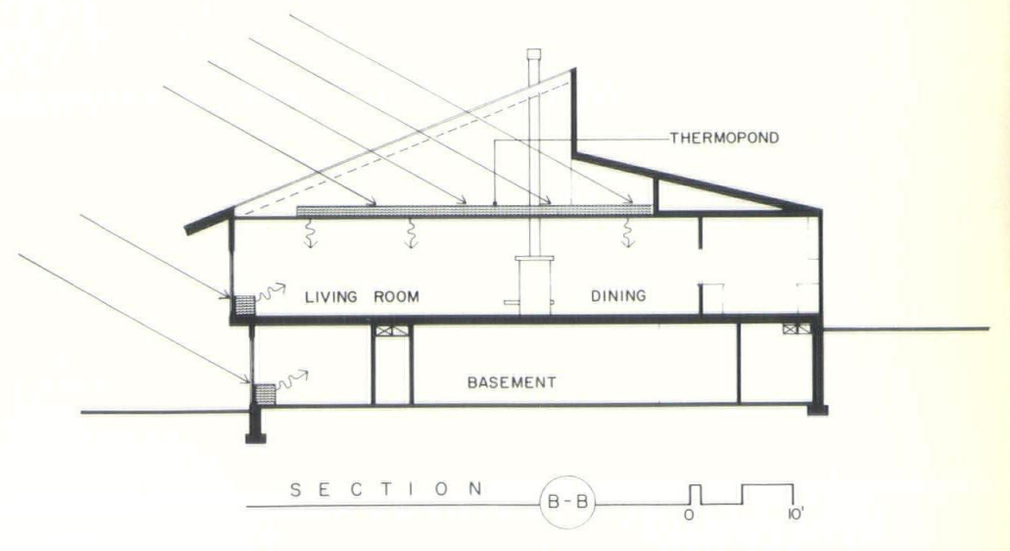
In our design, the central space (pool area and greenhouse) acts as a heat sink by directly collecting solar energy and radiating it to the surrounding spaces. In addition, the pool itself, and the surrounding rock bed storage, serves as the back-up heating system.

The thermoponds above the two side wings combine solar collection and storage in one location, thereby obviating the need for costly solar collectors and heat exchangers. Another direct method of solar collection is the use of water tanks directly below south-facing window areas.

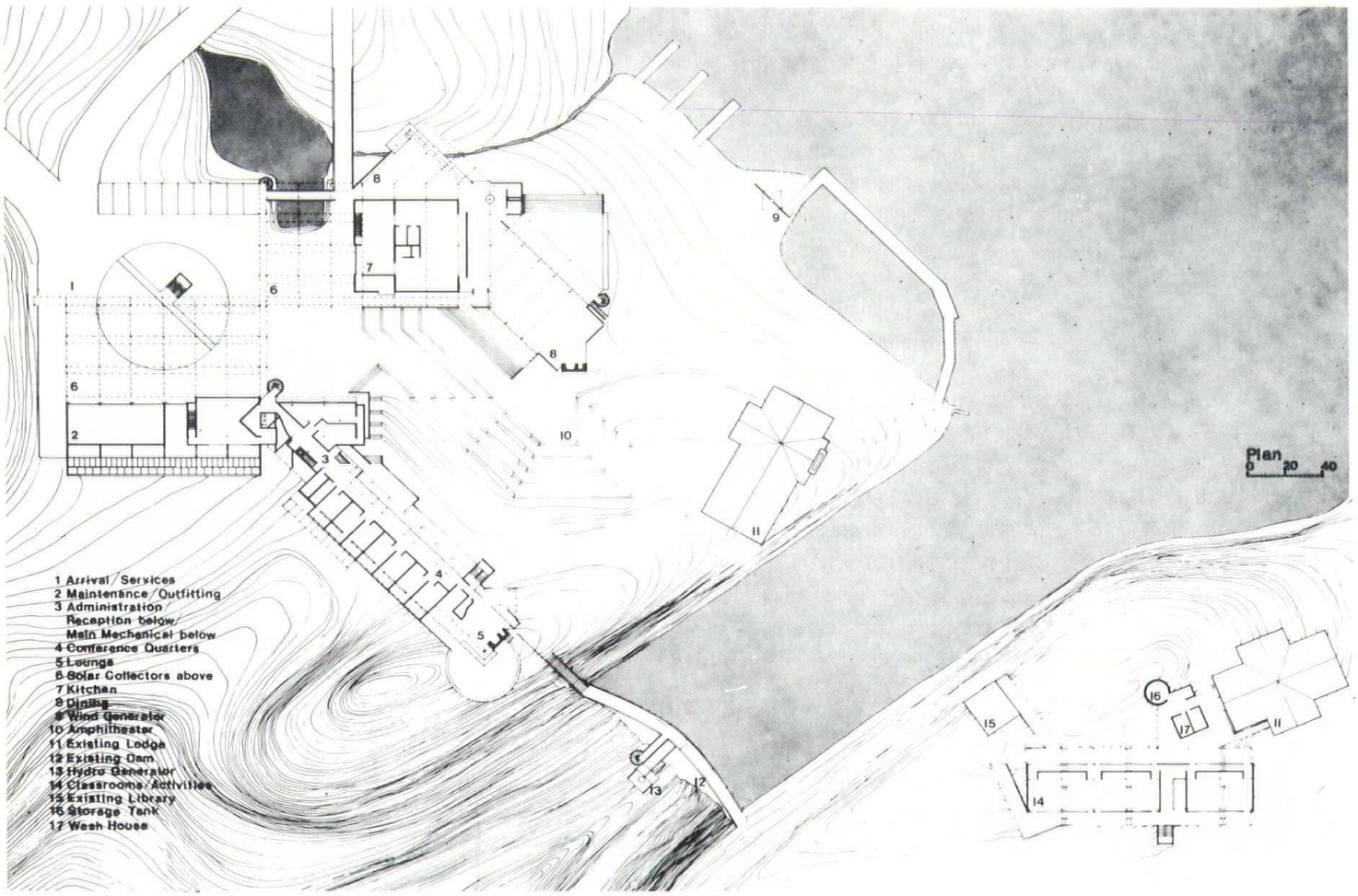
As a result of working on this project, we have determined that a more passive solar heating system offers greater flexibility to the designer, greater economy, and greater simplicity of mechanical systems."

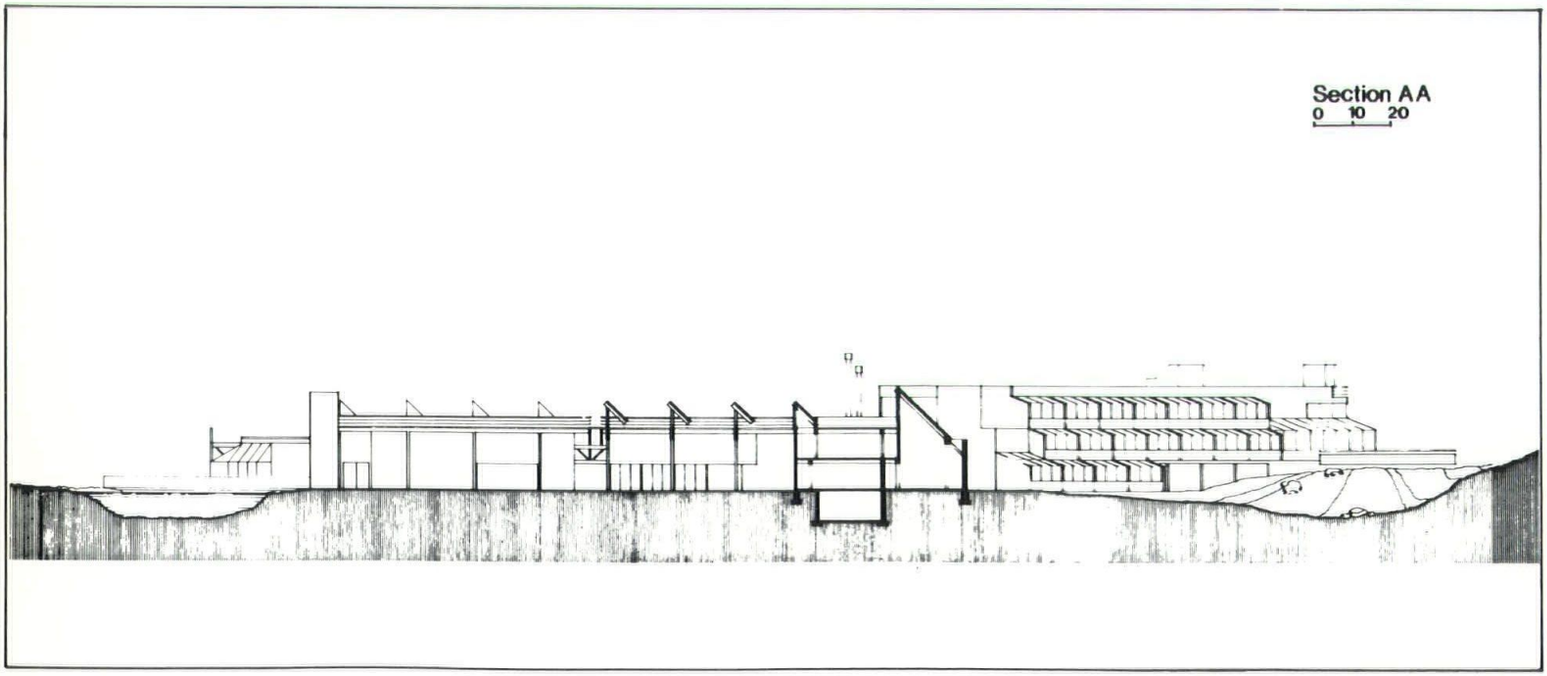






Sun, Wind and Water





Credits:
PRINCETON EDUCATION CENTER
Blairstown, N.J.

Architect:
HARRISON FRAKER, AIA
Princeton, N.J.

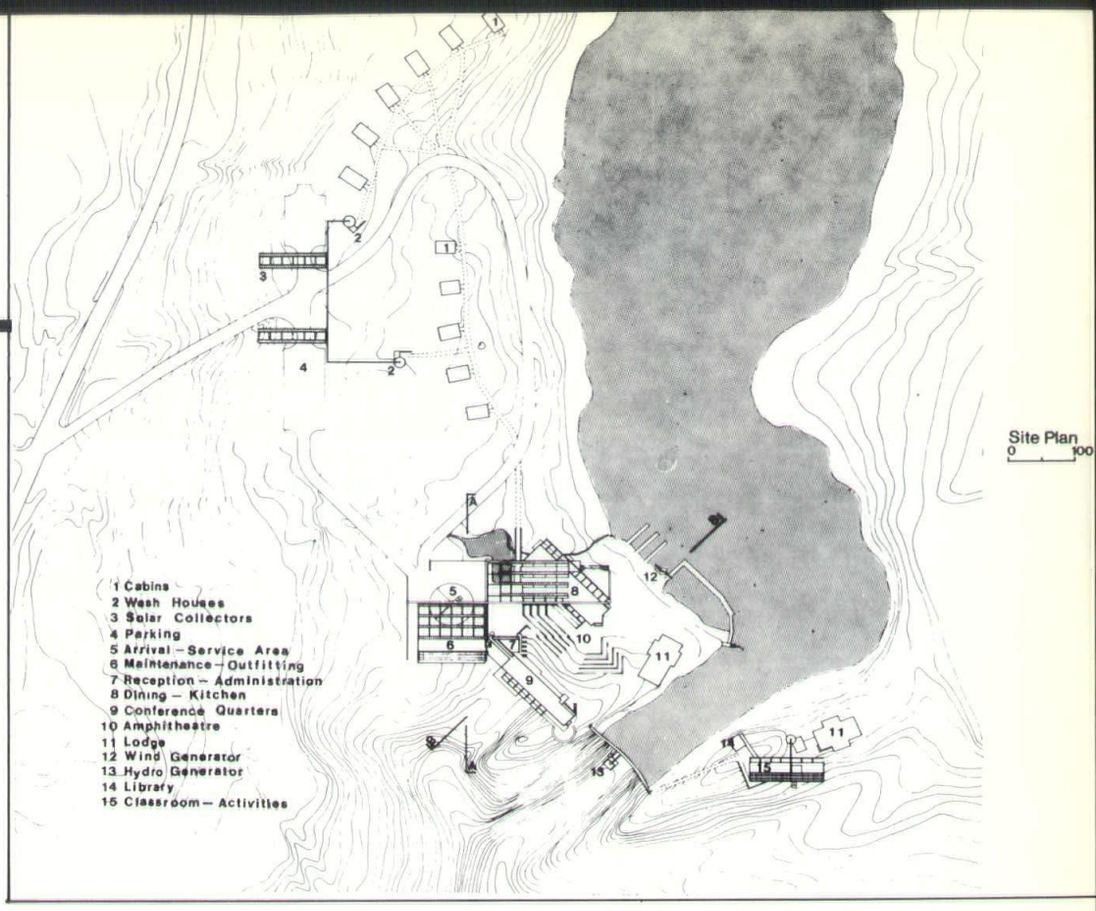
Consulting Mechanical Engineers:
FLACK and KURTZ
New York, N.Y.

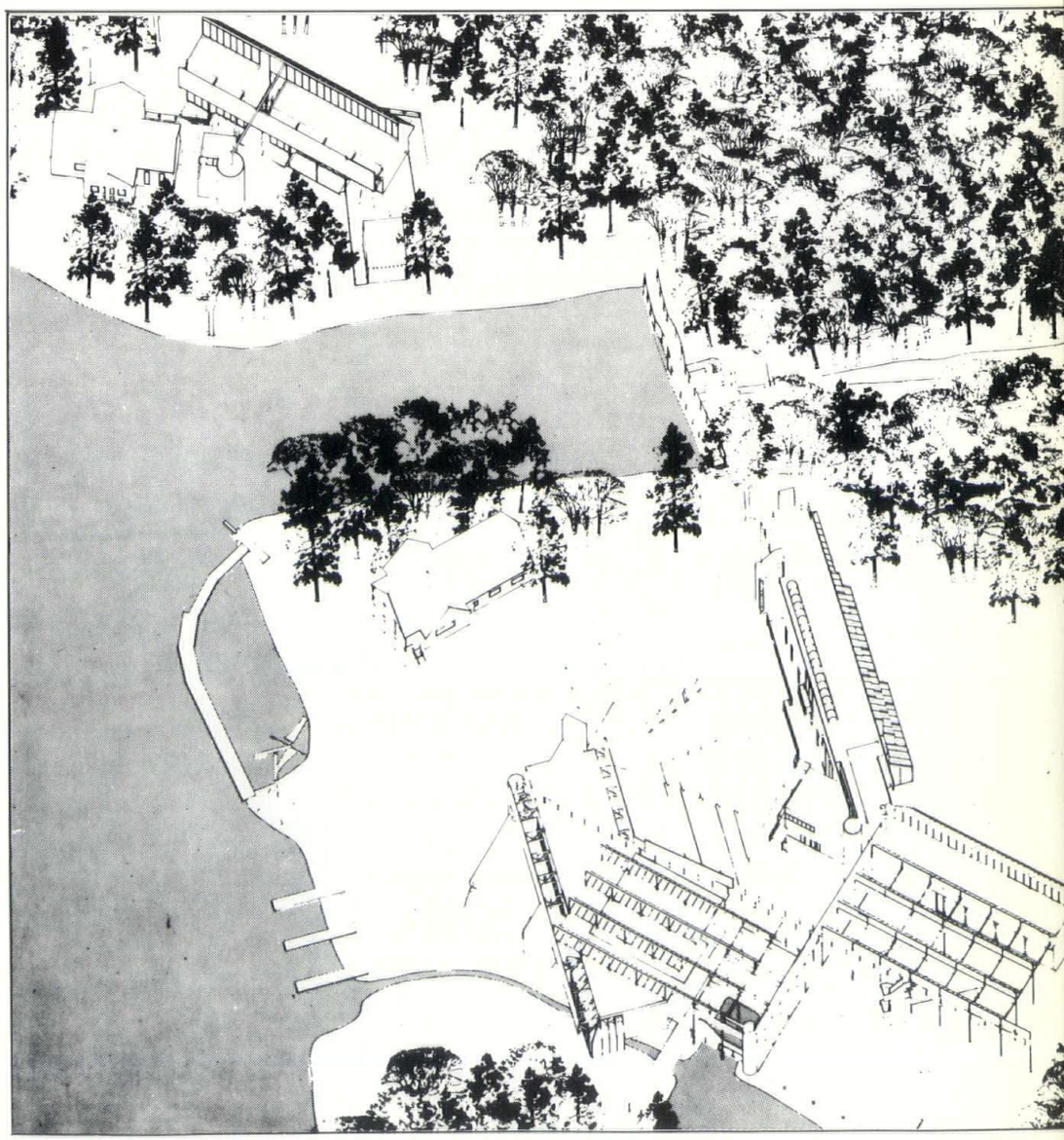
The conversion of an existing Blairstown summer camp into a year-round educational facility by Princeton architect Harrison Fraker is accomplishing two primary goals: the building and energy systems design are to demonstrate basic science principles and to illustrate a way in which the architectural enclosure can function as an environmental filter. In achieving these goals, Mr. Fraker's office has developed basic energy systems which utilize power available in the surrounding natural environment. Specifically, the sun, the water and the wind are being used in a system which will render the Educational Center almost totally self-sufficient by completion, relying upon a diesel generator for only a very small percentage of power.

Solar energy collectors will be mounted on the roofs of certain buildings, collecting the sun's rays to heat water, which will then be stored in insulated tanks with sufficient capacity to sustain the Center during three to four consecutive cloudy days. Thorough and extensive testing has indicated that the collectors will provide approximately eighty percent of the complex's space heating and virtually all of its hot water needs. A substantial portion of the Center's electrical requirements will be supplied through a combination of water and wind sources. The site's 26-foot waterfall will be used to drive a commercially available 12kw hydrogenerator (a unit on the market since the late 1800s), and on windy days the electrical supply will be supplemented by one or more experimental 6kw "sail-wing" wind generators, devices employing advanced aerodynamic technology rendering them far more efficient, economical and durable than conventional windmills. The energy so produced is to be stored in a bank of experimental lightweight zinc/chloride batteries (rated approximately ten times more efficient than lead-acid type batteries). It has been estimated that the water and wind will thus supply roughly ninety percent of the electrical needs of the Center, with the balance emanating from the diesel generator.

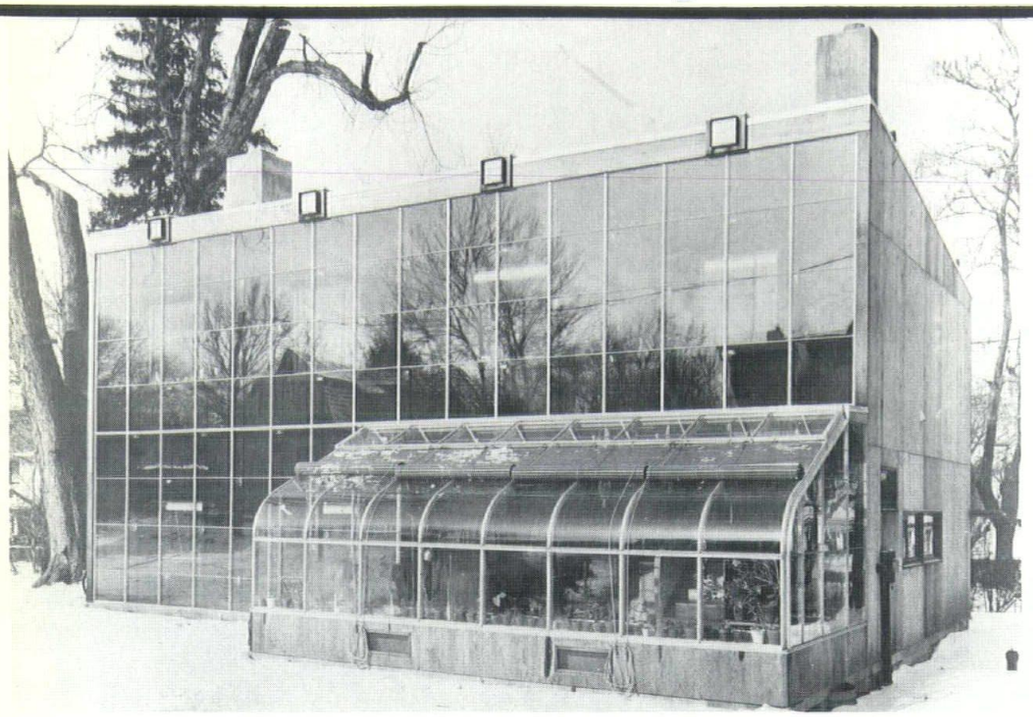
Building orientation maximizes southern exposure in turn protected by stands of deciduous trees, while pedestal-mounted mirrors placed about and behind the structure's north walls reflect sunlight into openings in the north wall, in effect creating two "south" walls.

Construction drawings have been completed for the first phase of the Complex's construction: a kitchen and dining facility. The second phase will involve the erection of a maintenance/workshop structure, while the third and final phase will concentrate on the construction of a classroom and laboratory facility.





A Passive Solar System

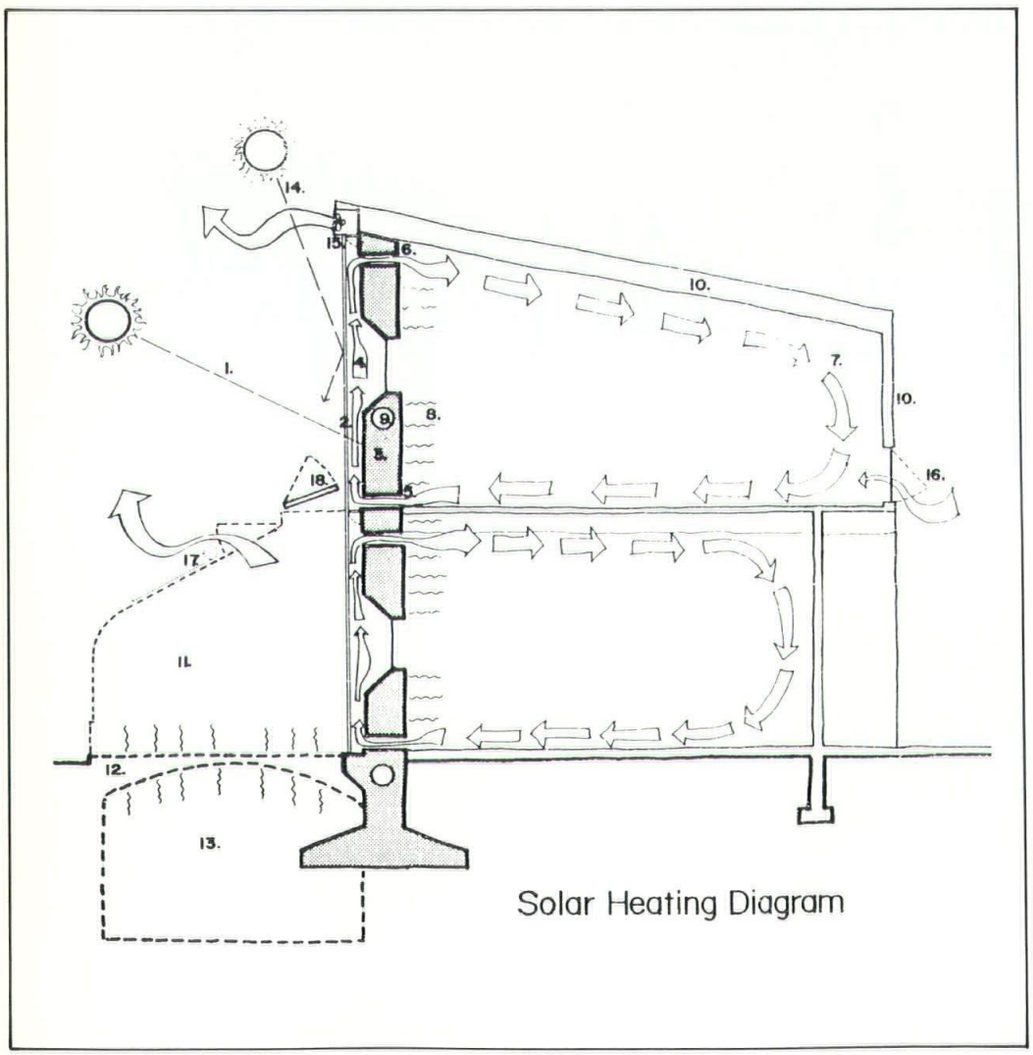


Credits:
KELBAUGH RESIDENCE
Princeton, N.J.

Architect:
DOUG KELBAUGH
Princeton, N.J.

Builder:
N. BARD
Roosevelt, N.J.

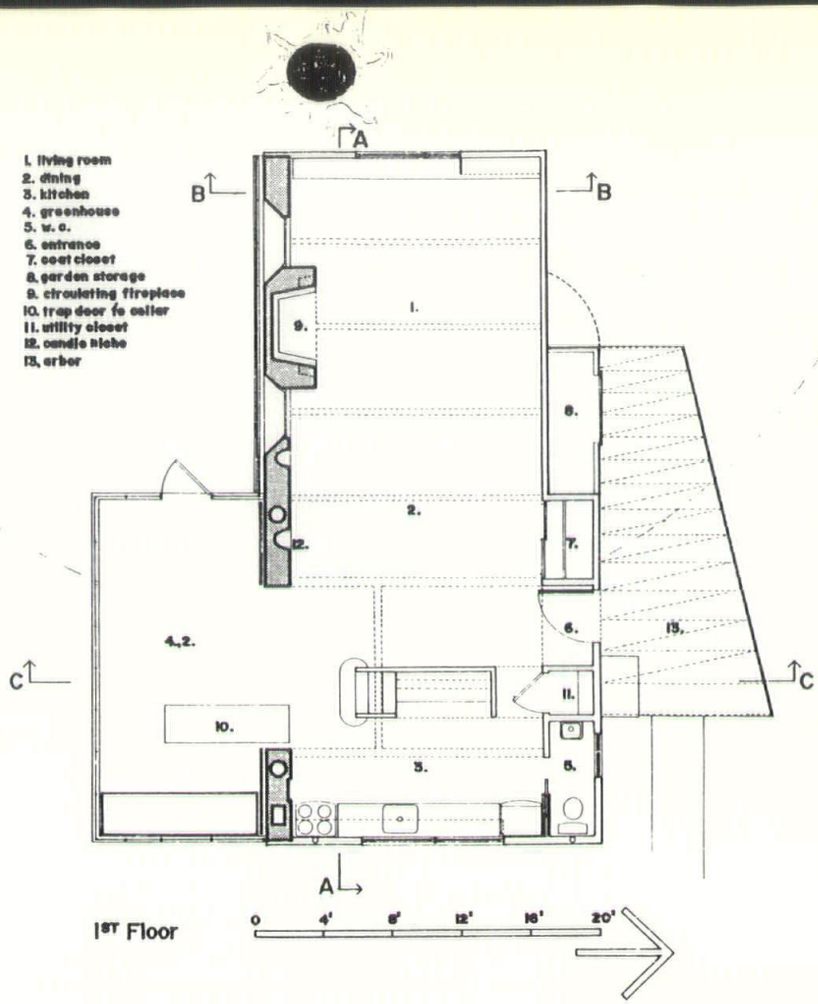
Completion date: July 1975



Solar Heating Diagram

The system Doug Kelbaugh selected for use in the design and construction of his 1900 S.F. home was developed in 1962 by Professor F. Trombe, Director of the Centre National de la Recherche Scientific At Odeillo, France. "This system is a passive one which will provide one-half to two-thirds of the necessary heat at the site's latitude with average winter insulation." Doug Kelbaugh goes on to explain: "As a system, it has relatively low efficiency, but then efficiency is not as critical with a free energy source as the low initial cost and architectural monumentality that this system affords. Systems using water or electricity have much longer storage capacities but are more expensive to install and are generally more architecturally redundant than the concrete wall which supports as well as heats half the house."

Solar Heat collection is via the entire south vertical face which is double-glazed. The rays of the winter sun (1), low in the sky, hit the south wall nearly perpendicularly, readily pass through the two sheets of glass (2) and hit the 18" thick concrete wall (3). The concrete is painted with a special black that absorbs more energy than it emits back. Some of the heat is radiated back towards the glass but at a much lower wavelength than sunlight. About two-thirds of the heat radiated back is retained inside because glass is opaque to low frequency heat. (Glass's transparency to light but opacity to heat is the common principle that normally heats a sunroom.) The warm wall and glass heat up the air which then rises up the air slot (4). This chimney effect sucks cool air in at the bottom (5) and vents warm sucks cool air in at the bottom (5) and vents warm air at the top (6). The warm air released at the top gradually cools and falls on the northern side of the room (7). The cooler heavier

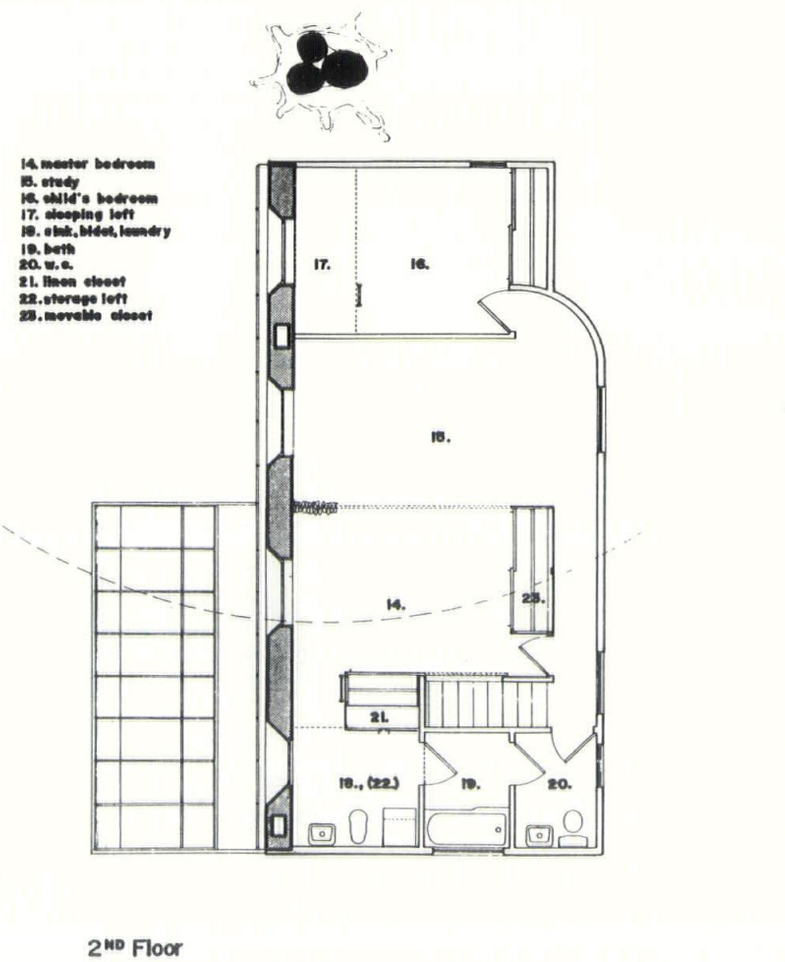


air is drawn over to the return hole in the concrete wall and back up the solar chimney. Thus, heat in the form of warmed air is circulated throughout the rooms of the house, all of which face onto the concrete wall. In the meantime the sun has been beating down on the concrete wall and slowly heating it through. By nightfall heat will have reached its inside surface (8) which, because of concrete's high thermal capacity, will radiate heat until the early morning. If it has been a cloudy day, the backup system will be started by thermostat. The backup system is a conventional hot air furnace with ducts (9) and registers in the concrete wall with one branch that leaves the wall to supply the bathrooms which are isolated from the concrete wall. The furnace is undersized because the skin of the rest of the house (10) is very heavily insulated.

A lean-to greenhouse (11) which acts sympathetically with the solar wall has been added to grow ornamental and edible plants. Its thick black concrete floor (12) will also store heat and help heat the cellar (13) as well as the greenhouse.

The rays of the summer sun (14), high in the sky, hit the southern wall at a more oblique angle and are primarily reflected off. What heat build-up there is can be exhausted by the four fans (15) at the top of the wall. In fact, the chimney effect and/or fans will ventilate the entire house by pulling air across the rooms from windows on other walls (16). Shades (17) must be drawn over the greenhouse because its glass is more perpendicular to the sun's rays. Two large deciduous trees will also provide protection from the summer sun.

Doug Kelbaugh adds that a solar water heater for domestic hot water will be placed (probably on the greenhouse deck) and adjusted seasonally (18).



News

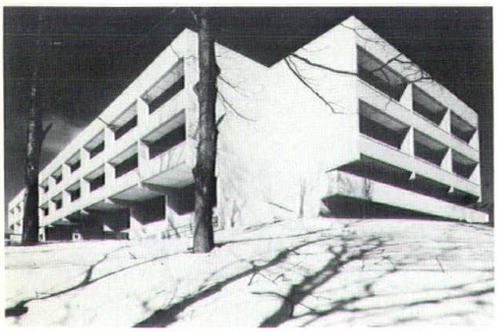
SPORTS COMPLEX IN ARABIA

Am Ar Consult, a division of Collins Uhl Hoisington Anderson, architects, engineers and planners of Princeton, has been awarded a contract to design an international bicycle-racing complex, at an estimated cost of $37 million, as part of a new Sports City in the Saudi Arabian capital of Riyadh.

The central elements will be two bicycle racing tracks. The first will be a covered, high-banked, wood-surfaced oval 285 meters long, with seating for 10,000 spectators. The second will be an open concrete-surfaced track, 400 meters long, for training and practice. The complex will include dormitory accommodations for 200 athletes, as well as bicycle storage and repair-shop facilities, and administrative, exhibition and clubhouse areas.

PHILIPS-KAUFMAN AWARD

The Prudential Insurance Co.'s new Woodbridge office for eastern operations was chosen as the outstanding concrete structure completed in 1975. Philips-Kaufman and Associates of Morristown were the architects.



The 13th annual competition was jointly sponsored by the N.J. Chapter, American Concrete Institute, and the N.J. Ready-Mixed Concrete Assn.

KELSEY SHOW LIVES!

The Central Chapter's exhibition of architecture past and present, with emphasis on New Jersey, may have a longer life than its summer run at the historic Kelsey Building in Trenton.

As a bow to the Bicentennial, the Central Chapter's painstakingly staged show was well-attended in July and August and drew numerous favorable comments. Portions of the exhibition later were shown at the annual convention of the New Jersey Society of Architects in Cherry Hill, and still later in an architectural exhibition at Monmouth Museum, Lincroft.

John M. Zvosec, AIA, of Princeton, chairman of the chapter's Bicentennial committee, said in August that efforts were being made to house selected exhibits in the Kelsey Building if the state went ahead with plans to use the structure for state offices.

The show consists of the work of Cass Gilbert, designer of the 65-year-old Kelsey Building, modelled after the Strozzi Palace in Florence, Italy. Gilbert was the architect of the U.S. Custom House and the Woolworth Building, New York, the U.S. Supreme Court and the state capitols of West Virginia and Minnesota.

Also shown will be displays by the N.J. School of Architecture and the architectural schools at Princeton University and Mercer County Community College, as well as 50-year interval growth patterns in five historically significant communities within Central Chapter boundaries, and the Charles Detwiller collection of architectural artifacts.

Included will be the plans and designs of Liberty State Park, Jersey City; designs from the city of Trenton; material contributed by the State Museum and State Archives, and work done by members of the Central Chapter.

A special exhibit will be the work of Antonin Raymond, FAIA, of New Hope, Pa., who was first employed in Gilbert's studios as a new immigrant from Czechoslovakia in 1908. Raymond later designed several foreign embassies in Tokyo and worked with Frank Lloyd Wright on the design of the Imperial Hotel, Tokyo, and with Gilbert on plans for the Woolworth Building.

'WALKING TOUR' ACCLAIM

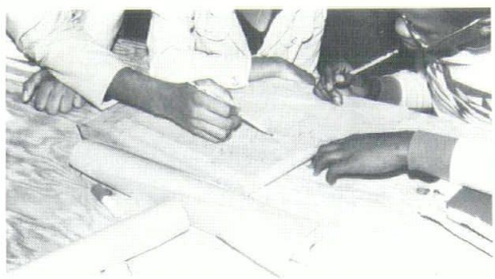
"A Walking Tour of Elizabeth," the cover story of Architecture New Jersey published in July, has engendered widespread favorable comment because of its emphasis on architecturally significant buildings in New Jersey's first capital. The city's Industrial Commission ordered 2,500 reprints of the article for use in its work.

Although historical treatment of Elizabeth is abundant, scant attention has been paid in print to its architectural heritage. The article was the result mainly of original research, but also with material excerpted from "Gateways to Architecture in Union County," an illustrated 28-page booklet by Beverly L. Brown and Sandy Brown, architectural historians of Summit. The booklet is published in honor of the Bicentennial by the Union County Cultural & Heritage Commission and is available to the public without charge.

AIS PROGRAM A WINNER

Youngsters in New Jersey are learning about the built environment through residencies with architects, designers and planners. The Artists-in-Schools program, under which this is accomplished, is sponsored by the N.J. State Council on the Arts in cooperation with the National Endowment for the Arts and local school districts.

Trenton High School, Roosevelt Elementary School and Frank H. Morrell High School, Irvington, participated in this year's program. Projects at each site ranged from exploration of early traditions and the concepts of "new towns" to redesigning a part of each school for a student activity center. In all schools architects worked with students to rediscover their immediate environments and to focus on making changes in given spaces.



Through the use of the built environment as a vehicle for understanding and teaching traditional academic subjects within an existing class, architects heightened design awareness and explored the design process with students and teachers. Resident architects this year were Martin L. Beck, FAIA, of Princeton; Louis A. DiGeronimo, AIA, of Fair Lawn, and Michael S. Adams, AIA, of Cherry Hill.

The AIS program encourages ownership of learning environments by the people who use them. Teachers and students begin then to define their own spaces, see their neighborhoods as resources filled with possibilities for teaching, and in some instances designing curricula for further environmental arts studies.

All schools in New Jersey are eligible for consideration for the AIS program. Architects, designers and planners interested in participating should submit resumes and 10 slides of their designs for consideration. Further information may be obtained by writing Linda Constant Buki, director of programs, N.J. State Council on the Arts, 27 W. State St., Trenton 08625.

BANK BUILDING AWARDS

Four bank buildings designed by Architect James Timpson, AIA, of North Caldwell were cited for awards in a Bicentennial competition sponsored by the N.J. State Department of Banking, to select the most historically and culturally reproduced buildings used as offices of financial institutions.

In the Commercial Bank category the Central Jersey Bank and Trust Co. in Freehold and the Citizens State Bank of N.J. at Forked River won first and second place. In the Savings and Loan category the Roseland office of the Glen Ridge Savings and Loan Assn. and the Main office of the Freehold Savings and Loan Assn. also came in first and second.

NEW DIRECTORIES AVAILABLE

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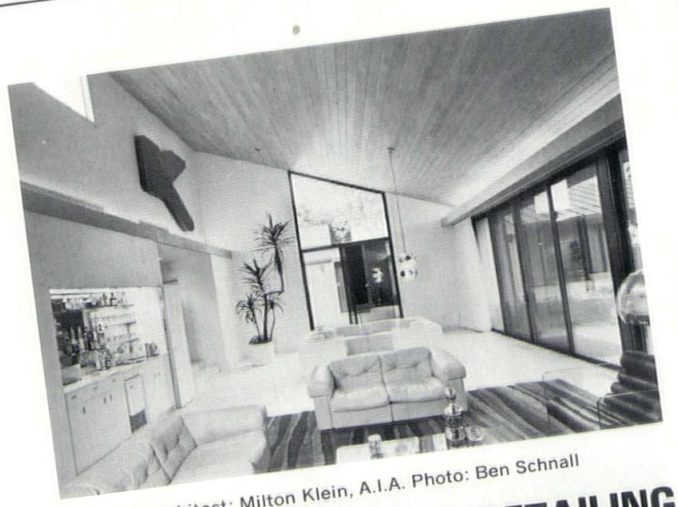

Architect: Milton Klein, A.I.A. Photo: Ben Schnall

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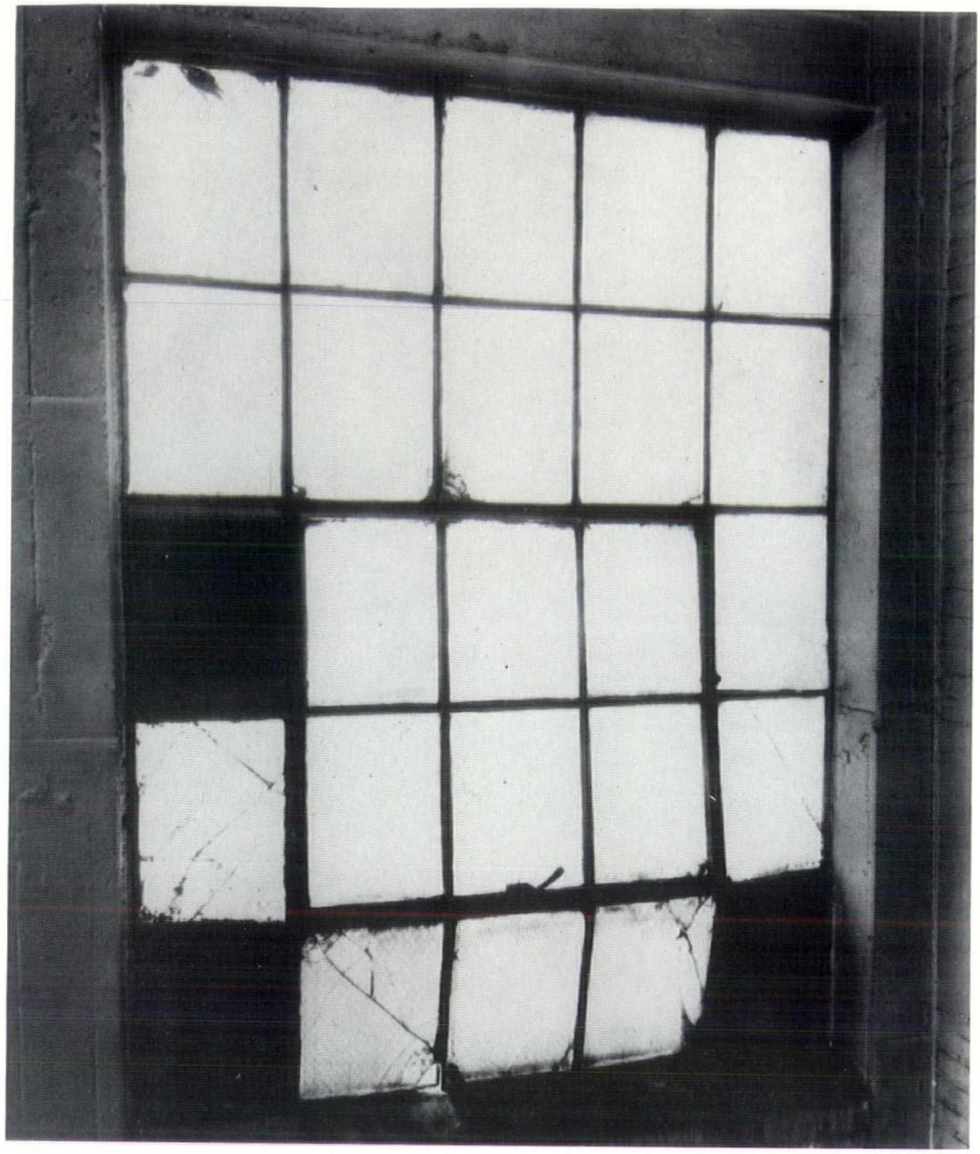

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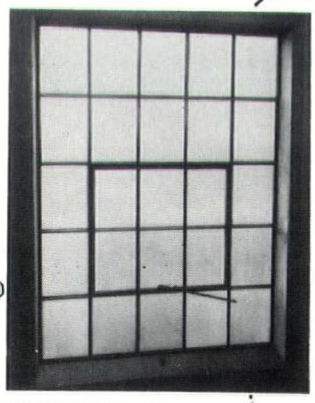

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